PROCEEDINGS\ACTA DE SESIONES

INTERNATIONAL QUEEN CONCH CONFERENCE
CONFERENCIA INTERNACIONAL DEL CARACOL REINA

STROMBUS GIGAS

San Juan, Puerto Rico
July 29-31, 1996

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PREFACE

On July of 1991, a workshop on queen conch (*Strombus gigas*) biology, fisheries, and mariculture was held in Caracas, Venezuela. It was organized in conjunction with the First Latin American Malacological Congress. At that time, Dr. Orlando Mora L., who was representing Colombia as the Director of the National Institute of Fishery and Aquaculture, suggested that resource managers from each of the Caribbean countries should meet with the objective of establishing a regional management plan for the queen conch. His initiative was immediately and unanimously supported by all the workshop participants.

Since that day, the idea remained in the mind of many scientific and management officers worried about the well being of the resource in the region. The need to implement a regional mangement plan was further advanced during the celebration of several international meeting (e.g., the Third Meeting of the Interim Scientific and Technical Advisory Committee of the Special Protocol for Protected Areas and Wildlife, in Colombia 1995 and the Western Central Atlantic Fishery Commission of the Food and Agricultural Organization of the United Natios (FAO), in Venezuela 1995). However, it is in 1996 when the visionary suggestion of Dr. Mora is materialized, thanks to the support of the Caribbean Fishery Management Council (U.S. Department of Commerce), the Government and the Department of Natural and Environmental Resources of the Commonwealth of Puerto Rico, and the Food and Agriculture Organization of the United Nations.

This First International Queen Conch Conference for the management of the resource properly fulfilled its expectations. This meeting was convened to bring together fishery managers with decisional power from the Caribbean Region to discuss the latest information available. The participants had the opportunity of listening to experts in the fields of scientific research, stock assessment, and management. Each country's representative then presented information on the status of their queen conch fishery and regulations. Finally, the participants aggreed as per the Declaration of San Juan, to promote regional management and a technical meeting to discuss a common international management strategy for the queen conch resource in the Caribbean Region.

These Proceedings compile the experiences of the First International Queen Conch Conference. This document is arranged in four parts. Section I includes the welcoming addresses and opening remarks from the delegates of those agencies which sponsored the event. Section II assembles three valuable contributions, which sumarize the experiences of many years of work in the areas of research, fisheries, and management of the resource. Section III comprises the contributions presented by the representatives from each country and Section IV reproduces the Declaration of San Juan.

There is no doubt that all these efforts are directed at encouraging communication and scientific cooperation and also, to sow the seed that will take us toward the implementation of a common management plan, or as integrated as possible, for the queen conch, *Strombus gigas*. This publication is here to permanently remind us of this direction; lets take the opportunity, the conditions could not be better.

J.M. Posada, *Editor*

PREFACIO

En julio de 1991 se llevó a cabo en Caracas, Venezuela, un taller sobre biología, pesquería y cultivo del caracol, *Strombus gigas*. Este se celebró en el marco del Primer Congreso Latinoamericano de Malacología. En aquel momento, el Dr. Orlando Mora L., quien representaba a Colombia en su calidad de Director del Instituto Nacional de Pesca y Acuicultura, propuso que los administradores de los recursos de cada uno de los países caribeños deberían reunirse con el objetivo de establecer un plan de manejo regional para el caracol. Su iniciativa contó con el apoyo inmediato y unánime de los participantes en el taller.

A partir de entonces, la idea se mantuvo en la mente de muchos científicos y oficiales de manejo preocupados por el bienestar del recurso en la región. La necesidad de implantar un plan de ordenamiento regional fue impulsada durante la celebración de varios encuentros de carácter internacional (ej., la Tercera Reunión del Comité Científico y de Asistencia Técnica del Protocolo para la Protección Especial de Areas y Vida Silvestre, en Colombia en 1995; y Reunión de la Comisión de Pesca para el Atlántico Centro-Occidental de la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO por sus siglas en inglés), en Venezuela en 1995). Sin embargo, es en 1996 cuando la visionaria sugerencia del Dr. Mora se materializa, gracias al patrocinio del Consejo de Administración Pesquera del Caribe (Departamento de Comercio de los Estados Unidos de América), del Gobierno y el Departamento de Recursos Naturales y Ambientales del Estado Libre Asociado de Puerto Rico, y de la Organización de las Naciones Unidas para la Agricultura y Alimentación.

Esta Primera Conferencia Internacional para el Manejo del Caracol Reina cumplió a cabalidad con sus expectativas. Esta reunión fue convocada, reuniendo a las personas con poder para decidir en materia de pesca en el Caribe, para discutir la información más reciente sobre el recurso. Los participantes tuvieron la oportunidad de escuchar a expertos en investigación científica, evaluación y administración pesquera. Cada representante presentó la situación pesquera y reglamento que aplica al caracol en su país. Finalmente, los participantes acordaron, según la Declaración de San Juan, promover el ordenamiento regional y una reunión de carácter técnico. El objetivo de la reunión técnica será el discutir una estrategia internacional de manejo común para el recurso del caracol en la Región Caribeña.

La presente publicación recoge las experiencias de esta conferencia. Está dividida en cuatro partes. La primera recoge las palabras de bienvenida y de apertura al evento por parte de los delegados de las diferentes agencias que auspiciaron la reunión. La segunda sección reúne a tres valiosas contribuciones, las cuales aglutinan la experiencia de muchos años de trabajo en las áreas de la investigación, la pesquería y el manejo del recurso. En el tercer segmento se agrupan las presentaciones realizadas por los representantes de cada país participante. La última sección nos presenta la Declaración de San Juan.

No queda duda que todos estos esfuerzos están orientados hacia el fomento de la comunicación y la cooperación científica, y hacia la siembra de la semilla que nos conduzca a la implementación de un plan de manejo común, o al menos integrado, para el caracol, *Strombus gigas*. Esta publicación está aquí para recordárnoslo permanentemente, aprovechemos la oportunidad, las condiciones no podrían ser mejores.

J.M. Posada, *Editor*

SECTION I: Opening session

Welcoming addresses and opening remarks

Hon. Pedro A. Gelabert
Secretary
Department of Natural and Environmental Resources
P.O. Box 9066600
San Juan, PR 00906-6600

On behalf of the Governor of Puerto Rico, doctor Pedro Roselló, the Caribbean Fishery Management Council, and the Department of Natural and Environmental Resources, it gives me pleasure to welcome you to Puerto Rico. The Governor asked me to respectfully convey his most sincere excuses, since he just came back from official tavel.

The Caribbean Fishery Management Council must be commended for taking the initiative to coordinate the efforts within the region, following the recommendation of the Interim Scientific and Technical Advisory Committee to the Specially Protected Areas and Wildlife Protocol (SPAW) of the Cartagena Convention (October 1995), and conveying this meeting on the queen conch, *Strombus gigas*. We applaud their efforts to gather such a well-versed group of scientists and fishery management officers from the region.

Unfortunately, the living conch is being adversely affected by its illegal meat trade, ocean pollution, and overfishing. The conch has being reduced to such low levels in certain localities, due mainly to overfishing, that might require a ban for its protection. International cooperation is urgently needed during the planktonic stage of the queen conch for its recovery and subsequent sustainable development in the Caribbean region.

The United States, including the Commonwealth of Puerto Rico and the Territory of the Virgin Islands, is actively involved in the conch trade. Conch populations have been depleted in many localities, and the nation is no longer a significant producer country. The conch fishing ban has been imposed for about a decade in Florida, but the conch population has not recovered. Although there are still conch fisheries in Puerto Rico and the Virgin Islands, Puerto Rico imports conch meats because its demand is much higher than its production. Records of the conch imports in U. S. annual reports under-represent the actual import volume. The primary demand for meat also produces a massive by-product of shells, which are internationally traded in diverse forms.

The Department of Natural and Environmental Resources has expressed that the key issues for the management of the queen conch are: 1) regulating the size of the conch harvest; 2) regulating the method of fishing; 3) closing of fisheries during spawning season; 4) conserving nursery areas; 5) reinforcing enforcement activities; and 6) keeping accurate statistics.

The purpose of this meeting is to compile the latest data on the queen conch, develop a common management strategy and make preliminary commitments for the adoption of the developed management strategy. The plenary session should be recommended to convene another meeting of plenipotentiaries to adopt the common strategy, as an official declaration of the queen conch by the countries of the Caribbean.

I respectfully suggest to follow other recent international agreements. In October 1995 during the Third Meeting of the Interim Scientific and Technical Advisory Committee to the Specially Protected Areas and Wildlife Protocol (SPAW) of the Cartagena Convention, the management needs and international trade controls of the queen conch became a priority

issue. The Committee decided that the issue should be addressed by the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Caribbean Fishery Management Council and other related authorities.

As a member of the United States of America delegation and signatary of the Cartagena Convention, it gives me great pleasure to participate in this two-day meeting as a preview for an international agreement on the queen conch. I respectfully suggest to follow other recent international agreements by discussing: (1) the applicability of previous agreements, (2) the precautionary approach, (3) transparency in the decision-making processes, (4) treatment of non-members. (5) compliance monitoring, enforcement and dispute settlements, and (6) treatment of new members. Probably, these issues will be faced in the development of the agreements, therefore, any resolutions offered during this meeting will certainly be enlightening.

Welcome, once again, to Puerto Rico.

Mr. Alcides Ortiz Ferrari
Sub-secretary of State
Puerto Rico Department of State
P.O. Box 3271
San Juan, PR 00902-3271

It is truly an honor for Puerto Rico to serve as host to an activity of such importance, one that will help provide the foundation for the systematic and balanced protection of queen conch, *Strombus gigas* L., a resource that has served as nourishment since the pre-Columbus era. Sadly, in our region, where queen conch was once abundant, it is now increasingly scarce. This is the issue that has brought you to Puerto Rico, as part of a concerted effort to protect this important economic, nutritional and natural resource.

The government of Puerto Rico, as part of the United States, is determined to join with our neighbors in the search for solutions to common regional problems, such as those that affect the protection of natural resources. Through conferences like this one, as well as through technical cooperation and educational efforts, you can be sure that we will maintain our determination to keep working together to protect the resources that future generations must also enjoy. The role of the Puerto Rico Department of State is specifically to serve as a catalyst, so that our state and federal agencies, as well as international organizations and our fellow neighbors' governments, can work to achieve regional progress and cooperation on this and other important issues like queen conch.

The tragedy that queen conch now suffers affects the consumers that share our taste for its place in the region's cuisine; affects the fishing sector, because it provides sustenance for hundreds of fishers and their families; affects small businesses since the queen conch shell is used in fine jewelry which is sold to tourists and other consumers; however, the most important consideration has to do with the effect of the loss of queen conch on the environment and ecosystem as a whole.

The statistics tell us that the quantity of queen conch caught in Puerto Rico in 1983 was over 182,508 kg (402,000 pounds). In 1992 (less than 10 years later), it had declined to less than 41,314 kg (91,000 pounds), a reduction of more than 300 percent. During the same period, the price of queen conch nearly doubled from US$ 3.00/kg to US$ 4.90/kg (US$ 1.37/pound to US$ 2.21 pound). Clearly, this situation can not be sustained and it will only improve through cross-sector cooperation and strict enforcement of agreed-upon standards and regulations.

I have been informed that one of the regulations we must make, our fishing industry abides by, is that we must not take queen conch specimens that are not yet mature or have not reached two and a half years of growth. It is a sacrifice that will have to be made, a fair sacrifice that must be enforced with vigilance and patience if we want to see a better tomorrow for the queen conch fisheries, and other resources as the manatees, the dolphins, the sea turtles, the humpback whales, and other species which are also being lost in great numbers due to ignorance, abuse and lack of enforcement.

I can not believe that losses of our natural resources will be the legacy of mankind to the next century. I can not believe that we are somehow unable to achieve the cooperation

necessary in order to prevent the disappearance of these creatures. It will be with your collective determination and the subsequent implementation of methodological practices to protect the queen conch that it will remain viable in the Caribbean basin.

Dr. Andrew J. Kemmerer
Regional Director
National Marine Fisheries Service
9721 Executive Center Drive North
St. Petersburg, FL 33702

On behalf of the United States Department of Commerce and National Marine Fisheries Service, I would like to welcome you all to this very important conference. I am anxious to hear the reports of our Caribbean neighbors on their efforts to manage the queen conch resource, so that we can learn and improve our own management and speed up the process of restoring these valuable populations of animals in U.S. waters.

The National Marine Fisheries Service is pleased of being part of the Caribbean Fishery Management Council's effort on the recently completed queen conch fishery management plan for the U.S. Caribbean. I believe that the size, the harvest limits, and the spawning season closure contained in this plan are a good start to begin restoring this extremely valuable fishery. We expect to have this plan approved and in effect in the federal waters of Puerto Rico and the U.S. Virgin Islands in the near future.

Hopefully, a common set of management principles for queen conch can be developed as a result of this conference, that will carry us all to the goal of a stable, sustainable fishery for queen conch throughout the Caribbean.

Mr. Rafe Pomerance
Deputy Assistant Secretary
Bureau of Oceans and
International Environmental and Scientific Affairs
U.S. Department of State
Washington, D.C. 20520

Let me begin this morning by thanking Governor Pedro Roselló of the Commonwealth of Puerto Rico, and Messrs. José Campos and Miguel Rolón, of the Caribbean Fishery Management Council, for inviting me to speak at the International Queen Conch Conference. I am especially honored to be here because I believe this conference represents a major opportunity to begin to develop a coordinated conservation and management strategy for queen conch and perhaps other shared Caribbean fishery resources.

I wish to add my welcome to San Juan to the representatives from Caribbean governments, to representatives from the Food and Agriculture Organization of the United Nations (FAO), and the Organization of the Eastern Caribbean States (OECS). This conference will certainly benefit from your diverse experience and expertise. I should also acknowledge the support provided by the Caribbean Fishery Management Council, the National Marine Fisheries Service at the National Oceanic and Atmospheric Administration, the Department of Natural and Environmental Resources of the Commonwealth of Puerto Rico, and the FAO which made this gathering possible.

Although as participants we represent diverse economies, geography, language and countries with different conch resource status, your presence demonstrates that we are joined by a shared commitment to ensure the sustainable use of this important fishery resource, and to the large promise offered through international fishery cooperation in the Caribbean region. Realizing the promise of regional cooperation, however, requires a strong foundation. Our collective efforts here, to agree on steps to restore queen conch throughout its range, can contribute to that foundation.

Today, we are witnesses to one of the most exciting and dynamic periods in international cooperation for the conservation and management of living marine resources. The level of activity around the globe is unprecedented and has resulted in the successful conclusion of a number of very important agreements, including a 1993 FAO agreement to regulate the activities of fishing vessels operating on the high seas, the adoption in November 1995 of the Code of Conduct for Responsible Fisheries, and the adoption in August 1995 of the landmark U.N. Agreement for the Conservation Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. This conference is not taking place in isolation from these other efforts, but rather is part of a growing awareness around the world that many important fisheries resources are in trouble and can only be effectively addressed through international cooperation.

I should also add that this conference reflects a renewed call by the United States for cooperation in dealing with many of the world's environmental problems. Our Secretary of State Christopher Warren stated in a major speech on the environment earlier in 1996 that each nation must take steps on its own to combat environmental threats, like overfishing of the world's oceans, but that we will not succeed until we effectively fight such problems

together. Moreover, this conference complements Secretary Christopher's mandate, that the United States is determined to put environmental issues where they belong: in the mainstream of U.S. foreign policy.

The FAO reports that over 70 percent of the world's fisheries are overexploited, fully exploited, or recovering. Here in the Caribbean, many stocks of fish, including the queen conch, spiny lobster and live rock from coral reefs, among others, need our attention. We want to work with you to help ensure that these fisheries receive the international attention that they deserve for the benefit of present and future generations.

I wish to share with you my thoughts on two topics. First, the conservation of queen conch, and secondly a vision on what we need collectively to contribute to the prospect of sustainable Caribbean fisheries generally. In this second part of my talk, I will suggest that the region needs to organize a new consultative mechanism to effectively coordinate the conservation and management policies for fishery resources which we share in the Caribbean region. Such a mechanism will build additional bridges of cooperation for the benefit of these shared living marine resources.

You are aware that the queen conch was once abundant, throughout the Caribbean, but is now in peril in many parts of the region. In many localities, queen conch has been fished to such low levels that a viable fishery no longer exists. In addition, the species is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), because of pressures from international trade, and under Annex III of the Protocol Concerning Specially Protected Areas and Wildlife (SPAW), to the Cartagena Convention, because the species would benefit from appropriate regulations.

Although queen conch are found mostly within coastal waters, it is widely recognized that recovery of this fishery requires a broader regional approach, because ocean currents carry queen conch larvae widely throughout the Caribbean Sea. Thus, we have come to San Juan to review and exchange the most current data on queen conch, and to obtain commitments from our fellow fisheries managers throughout the Caribbean Sea region to work toward adopting a common management strategy to restore the queen conch fishery.

The need for such a common management strategy has also received support from three fronts. First, the 1995 International Coral Reef Initiative (ICRI) Regional Workshop in Montego Bay, Jamaica, identified the improvement of fisheries management as a goal of ICRI in this region. Second, the Third Meeting of the Interim Scientific and Technical Advisory Committee to SPAW Protocol in October 1995 recommended the needs of the queen conch be addressed in collaboration with CITES, the Caribbean Fishery Management Council of the United States and other relevant bodies. Third, and most recently, the report of the FAO Western Central Atlantic Fisheries Management Council Commission (WECAFC), which met in Caracas, Venezuela, in November 1995, endorsed the view that the status of the queen conch fishery would be enhanced if a conference were convened to develop a common international management strategy for the fishery. Our successful efforts at this conference will answer these calls to action, will help prevent overfishing where healthy queen conch fisheries exist, and help restore the fishery elsewhere in order to ensure the long-term sustainable development of this important Caribbean resource throughout its range.

Before elaborating on the suggestion for a new cooperative mechanism, I would like to touch upon three broad requirements which, I believe, are essential if we are to embark on a course that can lead us to sustainable Caribbean fisheries. The first is that all coastal states must do a better job in managing their own fisheries. As history illustrates, the establishment of a 200-mile exclusive economic zones (EEZs) did not provide a panacea to ensuring effective fisheries management. Certainly, some states have done a better job than other in managing their fisheries. But in most cases, including the United States, the experience is mixed. Specific national fishery management decisions, of course, will vary according to the resource to be managed, the structure of government and many other factors. One of the objectives of the Code of Conduct for Responsible Fisheries is the establishment of principles and criteria to guide the development and implementation of national policies for responsible fisheries conservation and management. Although the Code is voluntary, I would urge all the nations of the region to review it carefully, as we will be doing in the United States, to see where the Code can help strengthen national fishery management policies.

Overall fisheries management in the region would also be enhanced if we all adopt and implement the U.N. Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, the FAO Compliance Agreement for Fishing Vessels Operating on the High Seas, CITES, and the SPAW Protocol. In addition, all nations that fish in the Atlantic Ocean or in the Caribbean Sea for pelagic species, such as tuna and swordfish, should become members of the International Commission for the Conservation of Atlantic Tuna (ICCAT), or at the very least, abide by ICCAT conservation measures for these species. In sum, the best way we can improve the status of Caribbean fish stocks, demonstrate our commitment to conservation and improve the contribution of fish to each nation's food security needs is by becoming better stewards of our own fishery resources, by working together to implement and strengthen international agreements; and to create new cooperative mechanisms when necessary.

A second broad course of action needed in the Caribbean is to better protect our coastal environments. In general, we can say that about half of the fish species in the oceans rely, at some point in their life cycle, on the coastal environment. As we all know, coastal environments, such as wetlands, estuaries, mangroves and coral reefs are easily damaged. Population growth places additional pressures on these fragile environments. In the future, we are likely to see increased amounts of sewage, sediment, industrial and agricultural runoff, and persistent organic pollutants enter the marine environment. If we do not deal with these adverse impacts and better protect our coastal environments, coastal areas will suffer. Ultimately, our fisheries and the economic benefits from tourism may be lost, and the general quality of life will deteriorate.

On the brighter side, some progress is being made in two critical areas. These include efforts to protect coral reefs, and to deal with land-based sources of marine pollution. Coral reefs are frequently described as the forests of the ocean, because of their rich marine biological diversity. We are fortunate that the coral reefs are abundant throughout the Caribbean region. Coral reefs and their associated ecosystems are important, not only at the local, national and regional level, but they are now of global significance as well. Many reefs in the Caribbean and throughout the world are seriously threatened due to human activity. Unless we begin to deal immediately with the threats in the Caribbean, our coral reefs will

degrade, which in turn will have an adverse effect on fisheries, food security, tourism, coastal environments, and marine biological diversity.

To bring attention to the special needs of coral reefs, the International Coral Reef Initiative (ICRI) was created at the Barbados Conference on the Sustainable Development of Small Island Developing States in April 1994. Following adoption of a Global Call to Action and a Framework for Action, a workshop to discuss regional and national opportunities for ICRI in the Tropical Americas was held at Montego Bay, Jamaica, in July 1995. At this workshop, the participants developed the regional agenda for action. They called for "improved conservation and management to ensure rehabilitation of depleted stocks, optimum sustainable utilization of fishery resources, and preservation of habitat and biological diversity of reef ecosystems". To achieve this goal, they agreed to reinforce "existing national and regional mechanisms, organizations for research and management, and dissemination of scientific information among countries utilizing common resources". Among the priority actions identified was a call to "establish a campaign to inform the public of the crisis facing coral reefs systems generally and the fisheries in particular, and to solicit active participation in fishery management strategy".

But much remains to be done to ensure the long-term health of Caribbean coral reefs. I hope you share my view that the fate of the queen conch, lobster and live rock, among many other species in the Caribbean waters, are linked to the future of the coral reefs. Each of these species depends, at least for some part of their life cycle, on healthy reef ecosystems. We should all support the regional efforts of ICRI and include coral reef protection as a high priority in our national fishery management policies. Some progress is also being made to address land-based sources of marine pollution (agricultural and industrial runoff, sewage and persistent organic pollutants), but again, more needs to be done in the Caribbean.

Last October, the United States hosted an intergovernmental conference in Washington, D.C. to define a global strategy and program of action for land-based sources of marine pollution. A global program was designed to promote, assist and reinforce action at the national and regional levels. We support the negotiation of a land-based Activities Protocol to the Cartagena Convention, to provide a mechanism to follow-up and implement the Program of Action adopted at the Washington conference in the Caribbean Sea region. Your governments' participation in this work will greatly help to improve the overall health of coastal environments, and we hope that you can all join together in this effort.

Thirdly, we must address the special needs of small island developing States in the Caribbean region. These States, more than a dozen of which are found in the Caribbean region, are especially vulnerable to environmental damage. Efforts to address the needs of small island developing States throughout the world were launched, not far from here, at the Barbados Conference on the Sustainable Development of Small Island Developing States in April 1994. The Barbados Conference adopted a Program of Action to assist the development of small island developing States. The United States remains committed to the spirit of the Barbados Conference, which emphasized partnership and important rules for both national governments and regional and international bodies, including regional development banks. Also, at the last session of the United Nations, we spoke out on the needs of small island developing States and specifically mentioned our concerns and efforts to restore queen conch in the coastal ecosystems of small island developing States in the Caribbean region.

The most important part of my vision is the establishment of a new consultative mechanism to effectively coordinate the conservation and management policies of fishery resources, which we share in the Caribbean region. The Caribbean Sea region certainly benefits from the work of FAO's WECAFC. It seems to me, however, that although this commission serves effectively as a forum for participating nations to share views and to make recommendations to the FAO, it meets infrequently and is not able to coordinate the fisheries management policies of its member States. Under the United Nations Convention on the Law of the Sea, coastal States exercise exclusive management responsibilities over the fishery resources within their respective zones. This exclusive authority does not abrogate each coastal state's duty to coordinate their fisheries management policies when necessary. On the contrary, Article 63-1 of the Convention states that:

> "where the same stock or stocks of associated species occur within the exclusive economic zones of two or more coastal States, these States shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary to coordinate and ensure the conservation and development of such stocks."

About one year ago, 100 countries adopted by consensus, the Agreement for Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. The agreement recognized the special need for international cooperation for these species, which roam both between EEZs and on the high seas. I believe we need to look to the spirit of the Agreement, with its emphasis on subregional and regional cooperation, and recognize the need to create a consultative mechanism to coordinate our fishery management and conservation policies for Caribbean fishery resources that would benefit from such a mechanism. Queen conch, for example, is a resource that would benefit from a consultative mechanism because its larvae is carried across the EEZs of many Caribbean countries by ocean currents. Consequently, the fisheries management policies of one coastal State along the journey of the queen conch larvae can have a significant impact on the fishery in another State. A similar need to consult on fishery policies applies to lobster, live rock and other species. Nature has made us partners in determining the future of many Caribbean fishery resources. Now, we have a duty to find a mechanism to coordinate our policies.

I believe establishment of such a consultative mechanism would serve a function very much needed in the Caribbean, especially if we are serious, truly serious about the long-term sustainable use of Caribbean fishery resources. I hope that you share my view on this point because the region needs and deserves its own mechanism to bring nations together to find ways that we can cooperate. Through cooperation and coordination, we can help ensure that the Caribbean fishery resources remain healthy for the benefit of all people and nations which call the Caribbean their home. With this vision, the United States is willing to take the initiative to begin to explore and define a structure of such a consultative mechanism.

In closing, I know you have much work ahead of you, many challenges, but also the opportunity to begin work on establishing a common management strategy for shared fishery resource. This strategy will represent a landmark achievement in Caribbean regional cooperation, and I wish you every success in this endeavor. I hope that you will have the opportunity to further reflect on the suggestion for establishing a consultative mechanism to

promote cooperative regional fishery management in the Caribbean. The United States is committed to working with you on queen conch and on future cooperative fishery management efforts.

Mr. Bisessar Chakalall
Regional Fisheries Officer
FAO Sub-Regional Office for the Caribbean
Central Bank Building
Church Village
Bridgetown, Barbados

It is indeed an honor and a pleasure to address you, on behalf of the Director General of the Food and Agriculture Organization of the United Nations (FAO), at the opening of the International Queen Conch Conference and to convey to you the greetings of the Director General of FAO, on whose behalf I also wish to welcome you.

The last meeting of the Western Central Atlantic Fisheries Commission (WECAFC), held in Caracas in November (20-24) 1995, endorsed this conference, and agreed that the status of the queen conch resource would be enhanced if a conference was to be convened to develop a common international management strategy for the queen conch fishery. I would like to take this opportunity to sincerely thank the Department of Natural and Environmental Resources of the Commonwealth of Puerto Rico, and the Caribbean Fishery Management Council of the U.S. Department of Commerce, for jointly organizing and sponsoring this conference, and the government of the Commonwealth of Puerto Rico for hosting it.

The world is changing in remarkable ways, unforeseen even a decade ago. New states, new issues, new institutions are reshaping international, political, economic and environmental relations. The new trends are clear. Most countries are seeking economic policies that are market-oriented. They desire broader international cooperation and sustainable development, together with the political structures that support them. It is trite today to say that we live in a global village and that we conduct business in a global economy, but it is a fact, and because what happens in other parts of the world does affect us, it is important to take stock of what is going on around us. How does this changing world and a globalizing economy affect fisheries, in particular fisheries in the WECAFC region and, as we are discussing here, the conch fishery?

Fisheries, including aquaculture, provide a vital source of food, employment, recreation, trade and economic well-being for people throughout the WECAFC region, both for present and future generations, and should therefore be conducted in a responsible manner. Total fish landings in the WECAFC region peaked in 1984 at about 2.5 million mt, then declined through the 1990's to about 1.75 million mt, and appeared to have leveled out at this amount in recent years. Given these figures, there is a general concern that a demand for fish, which continues to rise in response to expanding population and increasing disposable incomes, has exceeded available supplies globally. The experts of the WECAFC region have agreed that generally most of the fish stocks of the region were fully exploited and some were even over-exploited. Few stocks are under-exploited. In order to better match the supply with the demand, there is the urgent need for appropriate fishery management, better use of existing catches, to conduct fisheries in a responsible manner, and also for aquaculture development.

Fortunately, awareness and consciousness that humans must consider themselves the caretakers of nature are increasing and prevailing. In fact, evidence is mounting that humans, although adhering to different religions and philosophies, have come to believe in cooperate stewardship. This could permit us to obtain sustainability for the present and the future, and allow for development with increasing equity.

In 1995, a number of significant milestones were reached by the world community with regards to fisheries management. Four of these come readily to mind. They are the coming into force of the 1982 United Nations Law of the Sea Convention; the adoption of the United Nations agreement relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Stocks; the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels in the High Seas; and the adoption by the FAO Conference in November 1995 of the Code of Conduct for Responsible Fisheries. These milestones were preceded by the Cancún Declaration, arising from the International Conference on Responsible Fishing in 1992, and the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992, where the world community adopted Chapter 17 of Agenda 21, which deals with oceans, coastal areas and their living resources. These moves both encourage and reflect an international awareness of the need to alter drastically the historical exploitative attitude to living marine resources and to replace it with practices that encourage sustainable and optimum approaches to these invaluable and irreplaceable resources.

Of these, the Code of Conduct for Responsible Fisheries is particularly pertinent to this conference on queen conch, since it promotes the principle of sustainability of living marine resources and their environments, and the precautionary approach to management, while taking into consideration biological, economic, social and cultural realities. The Code is global in scope and is directed towards members and non-members of FAO, fishing entities, subregional, regional and global organizations, whether governmental or non-governmental, and all persons concerned with the conservation of fishery resources and management and development of fisheries; such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries.

The Guidelines to the Precautionary Approach to Fisheries (FAO 1995)[1] emphasize that sustainable utilization requires the application of "prudent foresight" and suggest that this includes, amongst others, the following attributes: 1) the avoidance of changes that are not potentially reversible; 2) the prior identification of undesirable outcomes and of measures that will avoid them; 3) that any necessary corrective measures are implemented without delay and are rapidly effective; 4) that where there is uncertainty, primary attention should be given to conserving the productive capacity of the resource; 5) that the fishing and processing capacity should be in harmony with the production potential of the resource, to avoid

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[1]FAO. 1995. Precautionary Approach to Fisheries. Part 1: Guidelines on the precautionary approach to capture fisheries and species introductions. FAO Fish. Tech. Pap. 350/1. 52 pp.

continual social and economic pressure to over-exploit the resource, in order to utilise this capacity; and 6) that all fisheries should be conducted according to an explicit and appropriate management plan and that the administrative and legal framework exits to ensure implementation of the plan.

These recent fisheries agreements and the Code of Conduct for Responsible Fisheries provide us with a framework and the backing for the adoption of measures to protect, conserve and utilize fishery resources of the region, not only for material interest and convenience, but that of future generations. The specific responsibility of this conference is the queen conch resource of the WECAFC region. It should be a useful exercise this conference deliberates on the conch fisheries of the region, to examine some of these approaches, particularly as contained in the Code of Conduct for Responsible Fisheries, and their implications for managing the queen conch fisheries of the Caribbean.

I am sure, given the expertise present and the demonstrated commitments and enthusiasm of this conference will rise to the challenge of setting the stage for the preparation of a management plan that would go a long way towards achieving the objective of sustainable utilization of the queen conch resource in the region. This would necessitate regional cooperation and joint management between the states with interest in the queen conch resource. This is strongly urged within the Code of Conduct for Responsible Fisheries. Such cooperation and joint management will probably necessitate the establishment of a regional conch management organization or arrangement. The exact nature of the organization or arrangement will have to be settled by the states themselves, but all states with interest should have representation within the arrangement or organization and where interested states are not members, they should be encouraged to become members.

These are some of the issues we will have to discuss over the next couple of days. In concluding, I would like to take this opportunity to wish you success in your deliberations, and look forward to your recommendations.

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Quisiera agradecer a las autoridades de Puerto Rico y al gobierno de Estados Unidos por haber convocado a esta reunión tan importante que estoy seguro sentará las bases para un plan de manejo regional del *Strombus gigas*. Quisiera agradecer especialmente el haber invitado a la Secretaría de la Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestre (CITES, por sus siglas en Inglés) a participar con ustedes en esta reunión.

La Secretaría CITES nace en Washington en 1973 y entra en vigor en 1975. Hoy en día cuenta con 132 países miembros, lo que la transforma en uno de los organismos de conservación y uso sustentable de la fauna y de la flora silvestre más importante de nuestro planeta. El preámbulo de la convención es muy claro cuando reconoce que son los estados y los pueblos los primeros que deben defender su fauna y flora. Asi mismo, el preámbulo reconoce que en muchos casos la cooperación internacional es absolutamente indispensable para proteger la fauna y la flora que entran en el comercio internacional. Estos dos considerados en el preámbulo de la convención, justifican que la Secretaría CITES esté hoy aquí con ustedes. Ustedes que tratan de conservar y de utilizar en forma racional un recurso natural, como el *Strombus gigas*, y nosotros, como sus representantes, para hacer validar ante la comunidad internacional lo que ustedes decidan.

Es un desafío el establecer un plan de gestión para una especie de amplia distribución geográfica y que se encuentra en serio peligro de manejo. Esto ya se alertaba en el Taller sobre Biología, Pesquería y Cultivo del *Strombus gigas* que se llevó a cabo en el marco del Primer Congreso Latinoamericano de Malacología, celebrado en Caracas, Venezuela en 1991. En 1992, durante la Octava Reunión de la Conferencia de las Partes, celebrada en Japón, Estados Unidos propone incluir el *Strombus gigas* en el Apéndice II de la Convención. A manera de recordatorio, en el Apéndice II están incluídas aquellas especies cuyo comercio internacional está permitido bajo un estricto control ejercido por los propios países, con la ayuda de los organismos competentes de los países importadores y la Secretaría de la Convención, que tiene su sede en Ginebra, Suiza. La Secretaría CITES apoyó la propuesta de Estados Unidos y recomendó a todos los países participantes a tomar acciones similares. La propuesta fue aprobada por unanimidad y entra en vigor 3 meses más tarde, tal como lo estipula el texto de la Convención.

Pasada la Conferencia de las Partes del '92, en la Secretaría nos comenzó a preocupar que los países involucrados en el comercio de esta especie no estuviesen informando sobre los permisos CITES, indispensables para toda especie que está incluída en Apéndice II. Dejamos pasar cierto tiempo para que los países informaran, en sus diarios oficiales, que la especie estaba incluída en el Apéndice II. A comienzo de 1993 decidimos efectuar una pequeña investigación, encontrando que en los restaurantes martiniqueses y de Guadalupe que existen en la Francia metropolitana se ofrecían platos de una especie que está en el Apéndice

II y que sin embargo, la Secretaría no tenía información de que haya habido la documentación necesaria obligatoria de importación. Nos entrevistamos con las autoridades administrativas francesas encargadas de aplicar la Convención y en octubre de 1993 Guadalupe y Martinica comienzan a solicitar los permisos CITES para la importación en territorio francés del *Strombus gigas*. Y es así cuando comienza a aparecer un comercio internacional, desconocido para nosotros, y que nos va a servir de base, primero para comprenderlo, y segundo para tratar de ayudar a todos los países a regular ese comercio internacional a través de la Convención.

Es así como entramos en contacto con todos aquellos países que exportaban, en primer lugar hacia Francia, como Jamaica, Turks and Caicos, y otros países del Caribe. Entramos en contacto con Cuba, para entender cuál era la situación de la especie en ese país, y por supuesto con Estados Unidos que ha sido crucial y nos ha llevado a esta reunión.

Estamos tratando de comprender un comercio totalmente diferente al de las especies con las cuales estábamos habituados a trabajar: los loros, los monos, los cocodrilos, etc. Y de ahí surge quizás el gran desafío que hoy todos nosotros tenemos que hacer frente. Quiero decirles que la Secretaría CITES está aprendiendo con ustedes. Creo que es la primera vez, en los 22 años de existencia de la Convención, que estamos tratando a un recurso a nivel regional.

El continente americano ha estado a la base de los 3 grandes éxitos que ha tenido CITES a nivel internacional. Saliéndonos un poco del *Strombus gigas*, quisiera recordar el primer éxito de la Convención. Esto ocurre en Estados Unidos, quienes trabajaron denodadamente, entre 1976 y 1979, para transferir sus poblaciones de caimán del Apéndice I (porque estaban totalmente amenazadas) al Apéndice II. Inmediatamente sigue Venezuela, cuyo comercio ilegal del caimán, *Crocodyilus crocodylus* L., causaba estragos en su población, perdiendo parte del recurso genético y las divisas que podría tener el país. Venezuela establece un plan de manejo pionero en la América Latina, y que hoy todos los países de la región tratan y nosotros estimulamos a que copien. El otro éxito ha sido la utilización racional de la vicuña en Perú y en Chile. Hago mis votos para que el próximo éxito lo tenga el Caribe, con todos los países que lo conforman, y demostremos a la comunidad internacional que somos capaces de manejar un recurso como el *Strombus gigas*. Sepan que la Secretaría CITES está a vuestra disposición para todo aquello que los ayude a lograr ese objetivo.

SECTION II: General overviews

Research, Fishery, and Management

STATUS OF QUEEN CONCH RESEARCH IN THE CARIBBEAN

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A BRIEF HISTORY OF QUEEN CONCH RESEARCH

Today there are approximately 230 published scientific papers on queen conch. Publication on this species began in the 1960s, and increased rapidly during the 1980s and 1990s (Fig. 1). The increase in publications after 1980 was associated with three particular areas of endeavor. First, numerous articles were published to document the rapid depletion of conch stocks in numerous localities within the Caribbean Sea. Second, substantial progress was made in understanding processes related to growth, mortality, and reproduction in queen conch. Third, because of the apparent and widespread decline in conch, several laboratories, especially those in Florida, Puerto Rico, Venezuela, and the Turks and Caicos Islands began experiments related to hatchery production of juvenile conch. The primary intent was to replenish wild stocks by releasing hatchery-reared animals. Today, hatchery production has been relatively well perfected and the increase in numbers of scientific papers related specifically to culture has slowed. A thorough review of the history of conch mariculture was provided by Creswell (1994), and Davis (1994) summarized the details of larval culture technique.

In the last decade significant progress has been made in our understanding of the general biology, habitat requirements, distribution, and mortality processes that influence populations of juvenile conch. There has also been considerable effort to develop techniques related specifically to stock enhancement through release of hatchery-reared juveniles. Research on stock enhancement is still increasing at a steady rate, primarily in Florida and México.

Little was known about the larval biology of queen conch prior to 1980. And, while culture technique was the primary focus of larval research in the 1980s, larval ecology and fisheries oceanography are the focus of those working with conch larvae in the 1990s. The first formal descriptions of the larvae of several *Strombus* species first appeared in 1993 (Davis et al. 1993) and we can now survey larvae quantitatively in the field. Publications on larval supply and transport, nutrition and length of life of larval stages, and larval settlement and recruitment are increasing rapidly. Another area of research that is new to the 1990s is related to the role of marine fishery reserves as a management tool for queen conch. All of these issues will be discussed below.

OBJECTIVES

An important scientific workshop on queen conch was held in Caracas, Venezuela, in July 1991. This workshop and the proceedings that emerged from it (Appeldoorn and

Rodriguez 1994) provided a good background on the status of research on biology, fisheries and mariculture for the queen conch. Because the general biology of queen conch is already relatively well known, the purpose of this document is to summarize some of the important advances made in the study of queen conch since the 1991 workshop. Emphasis has been placed on topics related to the ecology of queen conch that are most relevant to fisheries management and stock rehabilitation. In the following sections an attempt has been made to draw conclusions about habitat requirements for the species, mortality of juveniles as it relates to stock rehabilitation and enhancement, larval ecology and fisheries oceanography of the species, and the conservation of reproductive stocks. The author has not attempted to evaluate the efficacy of different management strategies because good data for such an evaluation are still relatively few.

HABITAT REQUIREMENTS AND NURSERY GROUNDS

While adult queen conch are now relatively uncommon in the shallowest regions of many Caribbean banks and island shelves, the most productive nurseries for the species tend to occur in shallow (<5-6 m deep) seagrass meadows. There are, however, certain exceptions, such as in Florida, where many juveniles are associated with shallow algal flats, and on certain deep banks such as Pedro Bank. Some juveniles are found in deeper shelf locations (>10 m depth), but these constitute a large proportion of the total juvenile source only in areas where shallow-water populations are very heavily impacted by fishing or habitat destruction.

Generally, larvae are transported by surface currents from spawning grounds onto shallow banks where the larvae settle and spend their first 2-3 years of life. Long-term studies near Lee Stocking Island in the Exuma Cays, Bahamas (Stoner et al. 1994, 1996a), and in the Florida Keys (Glazer, unpubl. data) have shown that aggregations of juveniles occur in the same locations year after year. Despite expansive distribution of seagrass beds in both the Bahamas and Florida, the conch nurseries occur in very specific locations within those meadows, and vast areas of seemingly appropriate seagrass beds are never occupied by conch. Near Lee Stocking Island, 90-95% of the vast seagrass meadow appears to be unsuitable for juvenile conch. Several factors appear to be important in providing environmental conditions appropriate for juveniles in the central Bahamas, and these principles appear to be relatively universal. Most nurseries are located in areas with an intermediate density of seagrass (usually 30-80 g dry wt/m2) and in depths of 2-4 m. On the Great Bahama Bank, the largest, most productive nurseries for queen conch are located directly in the paths of strong tidal current, and are flushed with clear oceanic water on every tide. Recent GIS (geographic information system) models of conch distribution (Jones 1996) show that the locations of conch nurseries can be predicted with some degree of accuracy using a combination of seagrass biomass, water depth, and tidal circulation patterns.

The association of conch aggregations with particular locations may also be related to patterns of larval settlement. Recent laboratory experiments have shown that a wide variety of biological substrata affects settlement and metamorphosis in queen conch larvae; however, substrata such as seagrass detritus and sediment taken directly from nursery grounds induce settlement at a much higher frequency than the same materials taken from non-nursery

locations (Davis and Stoner 1994). Distributional pattern in early post-settlement conch also indicates that most settlement occurs in the immediate vicinity of the long-term nursery grounds (Stoner et al., in review). Conch larvae are known to detect and settle in response to biological cues that are associated with subsequent high growth rates in the postlarvae (Stoner et al. 1996b), and juvenile conch are known to occupy areas that have exceptionally high algal productivity. It is also possible that conch larvae are concentrated in nursery areas before settlement. This will be discussed later under Larval Ecology.

The uniqueness of queen conch nursery habitats has important implications for both fisheries management and stock enhancement of this seriously overfished resource. Despite the presence of very large seagrass meadows in certain conch-producing areas such as the Bahamas, Belize, México, and Florida, only relatively small sectors of the meadows may actually have production potential for queen conch, either because they lack larval recruitment features or suitability as benthic habitat. Transplant experiments indicate that most seagrass beds, in fact, can not support juvenile conch. The most productive nursery habitats appear to be determined by complex interactions of physical oceanographic features, seagrass and algal communities, and recruitment of larvae. These critical habitats need to be identified, understood, and protected to insure continued population stability in queen conch.

JUVENILE MORTALITY AND RELEASES OF HATCHERY-REARED CONCH

For at least 20 years it has been proposed that releases of hatchery-reared queen conch could be used to enhance or rehabilitate depleted populations (Berg 1976). Mariculture technique for conch is relatively well perfected (Davis 1994), and there are now hatcheries in the Caribbean region, most notably the Caicos Conch Farm on the island of Providenciales, capable of producing millions of juveniles each year. However, high mortality has plagued conch planting efforts since the first releases were made in the early 1980s in Venezuela, the Bahamas, and Puerto Rico (see Creswell 1994). In recent years numerous investigators have examined the various factors that influence mortality rates in juvenile conch. These factors include conch size, season, abundance of predators, density of conch, structural complexity of the habitat (e.g., biomass of seagrass), and artifacts associated with hatchery rearing. Stoner and Glazer (in press) recently combined the results of their respective long-term experiments in the Bahamas and Florida to provide a new synthesis of mortality data for queen conch. Although increasing survivorship of juvenile conch is ordinarily assumed to be directly related to conch size and age, with some degree of refuge in size occurring between 60 and 100 mm shell length (Jory and Iversen 1983; Ray et al. 1994), Stoner and Glazer (in press) learned that factors such as season, year, location and conch density can have effects on survivorship as important as size. Recently, Ray et al. (in review) learned that there is a large suite of very small predators that consume conch in the first weeks after settlement. In Bahamian nursery grounds, the most important of these, by virtue of their abundance, were xanthid crabs less than 5 mm in carapace width.

Instantaneous rates of natural mortality (M), even in large juveniles, can vary by a factor of at least 10, from well below 1.0 to over 12.0 (Fig. 2). Because M is calculated as a logarithmic function, the probability of a conch surviving one year of life may vary by ten orders of magnitude, depending upon the time and location. It is clear that mortality rates of

conch in natural populations can be extremely high. For example, instantaneous rates of natural mortality for small juveniles are commonly as high as 8.0-9.0. This means that an individual conch will have about a 1 in 10,000 chance of surviving over the next year.

Although hatchery production of juvenile conch is now relatively routine, hatchery-reared conch can have certain morphological, physiological and behavioral deficiencies that increase their mortality in the field when compared with natural stocks. Stoner and Davis (1994) found that hatchery-reared queen conch grew more slowly than wild conch, had lower rates of burial, and they had shorter apical spines on the shells. All of these factors could negatively influence long-term survival of the hatchery-reared conch (Stoner 1994). On the basis of their review, Stoner and Glazer (in press) concluded that stock enhancement or rehabilitation depending upon hatchery-reared conch has a relatively low probability of success because natural mortality rates in juvenile queen conch are high, growth rates are low, and hatchery-reared conch have numerous deficiencies. The problem is exacerbated by the continuing high cost of hatchery rearing.

It is possible that conch stocks in some locations are now so low that they can not recover naturally. Larval recruitment data indicate that populations in the United States may be in this category (see section below). In such cases, stock rehabilitation may depend upon hatchery production, and the value of released conch will be determined by their survivorship to adulthood and their reproductive potential rather than their direct contribution to a fishery. Research in transgenerational enhancement may be particularly productive where populations have been severely reduced and fishing moratoria are in effect. Clearly, sound management of natural stocks is preferable to the daunting task of rehabilitating severely threatened stocks.

LARVAL ECOLOGY AND FISHERIES OCEANOGRAPHY

While the culture of queen conch larvae was relatively well perfected in the late 1980s, the larvae of queen conch and closely related species were formally described only a few years ago (Davis et al. 1993). The first data on larval abundance in the field were also published in this decade (Stoner et al. 1992; Posada and Appeldoorn 1994). Considerable progress has been made in the field of conch larval ecology and recruitment since the first descriptive studies.

We now know that conch larvae can be found in open water to depths as great as 100 m, but that most are found in the upper mixed layer of the ocean above the thermocline (Stoner and Davis 1997b). In calm weather most are in the upper 5 meters because of positive phototaxis (Barile et al. 1994). We also know that the larvae can develop in the field at rates higher than those typically observed in hatcheries using artificial diets. Davis et al. (1996) reported metamorphosis of queen conch in periods as short as 14 days for larvae reared in field enclosures with natural assemblages of phytoplankton for food. Growth rates are strongly temperature dependent and sensitive to the amount and types of phytoplankton food available in the water column (Davis, in prep.). However, we have also learned that the larvae are capable of remaining in the water column for very long periods of time (perhaps two months) after reaching metamorphic competence (Noyes 1996), and queen conch larvae have been collected in the mid-Atlantic Ocean near the Azores (R. Scheltema, pers. commun.).

The supply of conch larvae has a very important role in determining recruitment of conch to the nursery grounds and to the fishery. Recently, it has been shown that there is a direct positive relationship between the mean densities of late-stage larvae and the sizes of the juvenile populations in nursery grounds in both the Florida Keys and in the Exuma Cays, Bahamas (Stoner et al. 1996c). While the exact relationship was different in the two geographic regions, the fact that there is a close correlation between larval supply and juvenile population size within the systems indicates that the nursery grounds are not saturated with juveniles (i.e., the nurseries are below carrying capacity). Also, a positive correlation between year-class strength and larval supply has been observed near Lee Stocking Island in the Bahamas (Stoner, unpubl. data). These correlations, over both spatial and temporal scales, suggest that the populations of juvenile conch may be recruitment limited and that larval supply may determine the strength of recruitment on at least the local scale.

We have also observed that the locations of conch nurseries may be determined in part by local patterns of abundance in conch larvae. Near Lee Stocking Island, highest densities of late-stage queen conch larvae were found directly over locations known to support large aggregations of juvenile conch during surveys spanning seven years (Stoner and Davis 1997a). Large, stable aggregations of juvenile queen conch were consistently supplied with high densities of larvae and were directly associated with tidal channels carrying larvae from offshore spawning grounds. In contrast, more ephemeral aggregations were characterized by low or inconsistent veliger densities (particularly late-stage larvae), and were generally outside primary tidal current pathways. Distribution of juvenile queen conch appears to be directly related to the horizontal supply of larvae.

Correlations between larval supply and juvenile population size over both spatial and temporal scales, along with data from transplant experiments, suggest that populations of queen conch are often recruitment limited, not habitat limited. Larval limitation implies that pre-settlement phenomena, such as growth and mortality during planktonic stages and larval transport may be critical to population dynamics in queen conch. The positive relationship between larval supply and population size suggests that we need to understand transport processes and the mechanisms affecting larval supply to nursery grounds in order to understand recruitment process and year-class strength.

The relationship between oceanography and delivery of queen conch larvae to nursery grounds has been investigated in two systems -- in the Exuma Sound, Bahamas, and in the Florida Keys. Both studies show the dependence of populations upon upstream spawners.

In the Exuma Sound, Bahamas, prevailing summer surface currents carry larvae away from the eastern rim of the Sound near Cat Island and onto the banks near the Exuma Cays on the western side of the Sound. Also, mesoscale gyres in Exuma Sound generally advance toward the northwest (B. Hickey, unpubl. data), transporting and concentrating larvae in the northern end of the system. The result is very large juvenile populations in the northern Exuma Cays and southern Eleuthera, and an historic record of high fisheries productivity in the northern Sound (Stoner 1997). The full oceanographic interpretation of this mesoscale phenomenon is in progress.

The delivery of larvae to nursery grounds in the Florida Keys has also been analyzed (Stoner et al. 1997). In Florida, the queen conch population has been reduced to such an extent that all conch fishing was banned in 1985. Between 1992 and 1994, estimates for the

total number of adult queen conch in the entire Florida Keys island chain (250 km long) were between 5800 and 9200 individuals, and the Florida Department of Environmental Protection has concluded that the population has shown no sign of recovery (Glazer and Berg 1994; Glazer et al., in press). The fishing moratorium is still in effect.

Because there were so few queen conch in the local reproductive stock, Stoner et al. (1996c) postulated that the population in Florida is replenished with larvae produced outside the United States in the western Caribbean Sea (México and Belize) and delivered to the nurseries on the Florida Current. To test this hypothesis, 35 collections of larvae were made in the Looe Key National Marine Sanctuary during the reproductive seasons of 1992 and 1994, concurrent with the deployment of a current meter array immediately offshore. In brief, most of the queen conch larvae collected at Looe Cay were late-stages that arrived in association with northward meanders of the Florida Current (Stoner et al. 1997). Late-stage conch larvae were never collected when the north wall of the Florida Current was offshore in the Florida Straits.

There are large spawning stocks in Belize and México and recruitment of late-stage queen conch during periods of high eastward flow at Looe Key is consistent with the hypothesis that they have a source in the western Caribbean Sea. The 3-4 week development period for queen conch larvae (Davis et al. 1993) in combination with average current velocities in the Loop Current and Florida Current system would permit transport from the Yucatán Strait to the Florida Keys. Concentrations of late-stage larvae are known to be high in the Florida Current 35 km south of the middle Keys (Stoner et al. 1996c), and arrival of conch larvae in association with easterly flow at Looe Key suggests that larvae of Caribbean origin are being delivered by the Florida Current. Although the genetic similarity between queen conch in the Caribbean Sea and Florida indicates significant gene flow (Mitton et al. 1989; Campton et al. 1992), the newly published study (Stoner et al. 1997) provides the first oceanographic data indicating that a population of queen conch is dependent upon a source in an upstream nation.

It is possible that queen conch populations in Florida were historically self-sustaining, when adult populations were large. Today, however, recruitment appears to depend to a large extent on irregular and unpredictable northward meanders of the Florida Current. This would explain the lack of recovery in spawning stocks of queen conch since the fishing moratorium was established in 1985. Rehabilitation of this stock may now depend upon transplanting spawners or releasing hatchery-reared juveniles. However, stock enhancement through release of juveniles is difficult and expensive because of high potential mortality (described earlier) and has a history of low success (Stoner 1994; Stoner and Glazer, in press). Wise management and transgenerational enhancement of marine fishery resources will depend upon extensive knowledge of larval transport and recruitment processes.

Sources of larvae may be local if retention mechanisms are strong, or they may be distant, supplied by other nations. Although little is known about large-scale patterns of abundance and larval transport for any species in the Caribbean region, it is likely that most of the national populations are interdependent because of larval drift. This "open" nature of the populations requires that population dynamics be considered from a metapopulation perspective (see Gilpin and Hanski 1991). In the theoretical model presented in Figure 3 there are three subpopulations connected by larval transport. Population 1 is maintained by

local recruitment (RL) and has no recruitment by immigration from other sources (RI). Reproductive (larval) output from Population 1 is greater than local mortality (M), and some of that output is exported to downstream populations (E). In metapopulation terminology, this population is a "source". Populations 2 and 3 are downstream from Population 1 and receive larvae both from local spawners (RL) and from upstream sources (RI). By definition, Population 3 is a "sink" because reproductive output is less than local mortality, and most larval production is lost from the system. Population 2 is a "source" for Population 3, but may also be a "sink" depending upon the relationship between RL and M2.

Practical examples of "sources" and "sinks" can be hypothesized in the Caribbean region. The Windward Islands are probably "source" locations, analogous to Population 1 in the model because of the general east-to-west circulation of surface waters through the Caribbean Sea. In the eastern Caribbean, populations of queen conch and other species with pelagic larvae must be maintained by local recirculation patterns. Island-scale self-recruitment mechanisms have been discussed in general by Farmer and Berg (1989), and more specifically for Bermuda (Schultz and Cowan 1994) and Barbados (Cowan and Castro 1994) which are probably dependent upon local retention of fish larvae. Florida populations may receive larvae from local spawning populations; however, the populations are so low today that Florida is probably a "sink" with heavy dependence upon upstream sources of larvae, as described earlier. Important conch-producing locations such as Belize and Pedro Bank are probably more analogous to Population 2 in the model, with characteristics of both "sources" and "sinks".

Position within the metapopulation structure can have important management consequences. For example, a source population will be highly vulnerable to recruitment overfishing, and emphasis must be placed on maintaining an effective and sustainable reproductive stock quality. Downstream populations are also dependent upon larvae from these source populations. A sink-type population is more susceptible to management practices occurring in the upstream source locations than to those effected by local management practice. Recovery of depleted stocks requires an adequate source of larvae which may or may not be local. For these reasons, a strong effort should be made to identify the sources of larval recruitment for target populations, and stock management should be based upon the associated metapopulation structure. In the Caribbean region, management of the queen conch resource must be considered a multinational issue.

CONSERVING REPRODUCTIVE STOCKS

It is obvious from the previous discussion that it is important to maintain a regular, high-density supply of larvae to queen conch nurseries by preserving reproductive populations of adequate size. Reproductive stocks and reproduction are protected by a variety of management techniques that have been discussed by others. In this section, results from two new investigations bearing on the role of conch reproduction are described.

In the summer 1995, the Caribbean Marine Research Center conducted surveys of adult conch in the Exuma Cays, Bahamas, to test for hypothesized relationships between adult conch density and reproductive behavior (Stoner and Ray, unpubl. data). Protection of conch in the Exuma Cays Land and Sea Park presented the unusual opportunity to examine a wide

range of spawner densities, from a few conch per hectare to approximately 650 per hectare. The surveys showed that 10-30% of the conch were usually laying eggs at any one time and place during the summer reproductive season, but the data suggest a decline at densities less than approximately 50 adult conch/ha. Similar declines were observed in the relative abundance of mating pairs of conch at approximately 50 conch/ha. Given that reproduction in queen conch requires internal fertilization of eggs, it is possible that some threshold of adult density is required for males and females to detect one another and mate. The exact density at which reproduction is depressed probably varies with location, the overall size and scale of the population, and natural aggregation of adults during the summer spawning season. However, it is clear that a minimum spawner density is important for successful reproduction in queen conch. While quantitative surveys have been made in a relatively few locations in the greater Caribbean region, 50 adult conch/ha is significantly higher than the densities reported in many locations including Bermuda, Florida, Puerto Rico, the U.S. Virgin Islands, and Venezuela in recent years (see Stoner and Ray 1996).

There are at least two ways to protect high densities of adult queen conch. Both mechanisms provide refugia:

Depth Refugia: Queen conch are herbivorous, consuming micro- and macroalgae throughout their lives as benthic juveniles and adults. Therefore, conch are found in well-lighted regions of the marine environment from the shallowest subtidal zone down to depths of about 35-40 m in clear Caribbean water. There have been a few reports of queen conch observed in depths to 60 m but these individuals are very rare.

Detailed depth distributions for adult conch have been reported for Puerto Rico, the U.S. Virgin Islands and the central Bahamas. In Puerto Rico, maximum adult density occurred at 20-25 m, but the densities at this depth were very low (0.05 conch/ha) (Torres Rosado 1987). This deep distribution of adults was attributed to fishing pressure. In less heavily fished waters of the U.S. Virgin Islands, adult density was maximum (17.1 adults/ha) in a depth range of 18-24 m (Friedlander et al. 1994). Near Lee Stocking Island in the Bahamas, maximum density (88 adults/ha) was observed in 15-20 m depth, and densities were approximately 18 adults/ha in 20-25 m depth (Stoner and Schwarte 1994), similar to values in the Virgin Islands. Although direct comparisons must be made with caution, it is clear that where fishing is open to SCUBA diving, as in Puerto Rico, maximum abundance of adult conch is driven to great depth, and numbers at all depths are very low generally. This is in sharp contrast with relatively natural populations of adults in the Exuma Park where highest abundance of adults (270 adults/ha) occurs in depths of just 10-15 m (Stoner and Ray 1996; Table 1). In the Bahamas, where fishing is limited to free diving, adult conch are relatively uncommon in depths shallower than 10 m but densities increase rapidly with depth beyond the reach of the average free-diving conch fisher.

Very few conch live deeper than 30 m, and virtually all are accessible to fishers using SCUBA. One potential form of management for a healthy reproductive population, therefore, is to limit fishing to free-diving. However, because the vast majority of queen conch spend their first 2-3 years in shallow water young adults and adults that do not migrate to deep water are all accessible to free-divers, it is possible that intense fishing for conch in shallow water could ultimately reduce deep-water stocks. This apparent dilemma was discussed earlier by Stoner and Ray (1996).

Marine Fishery Reserves: Closed areas represent another mechanism for maintaining high densities of adult conch. The Exuma Cays Land and Sea Park is a marine fishery reserve established in 1958 and administered by the Bahamas National Trust in the central Bahamas. The Park is large, spanning a section of the northern Exuma Cays 40-km long and 8-km wide. No fishing of any kind has been permitted since approximately 1984. Stoner and Ray (1996) conducted extensive, depth-stratified surveys in the Park and near Lee Stocking Island to compare the abundance of adults, juveniles, and larvae of queen conch in a marine fishery reserve and in a nearby fished area of the Exuma Cays. Large differences in densities of adult conch between the reserve and the fished area are obvious (Table 1). Differences in densities of adult conch were significant in all depth zones down to 30 m, except in the very shallow shelf region (0-2.5 m depth), and, as would be expected, this marine fishery reserve conserves spawners. One of the most notable differences between the two sites was that densities were 30 times higher in the shallow bank environment of the reserve than in comparable habitat in the fished area. The bank represents a very large habitat in the Exuma Cays and the contribution of the bank to the adult population was enormous. Additionally, the density of conch on the bank in the reserve was sufficiently high to promote reproduction in that habitat.

Because of the high abundance of spawners there were approximately 10 times more newly-hatched larvae in the unfished area than the fished area (Stoner and Ray 1996). An alongshore drift of about 1.5 to 3 kilometers per day and a mesoscale gyre in the northern Exuma Sound then carry larvae produced in the fishery reserve to nurseries in the northern Exuma Cays and southern Eleuthera. Reports from fishers and from the Department of Fisheries indicate that the numbers of juvenile conch have increased in these areas over the last 10 years, the time period during which fishing has been closed in the Exuma Park. Although the data must still be considered preliminary, the high production of larvae in the fishery reserve undoubtedly contributes to fished populations in downstream areas.

The apparent success of the Exuma Cays Land and Sea Park in protecting spawning stocks of queen conch and in producing high numbers of larvae for export to surrounding areas is due, in part, to its large size (approx. 320 km2). Reserves must be large enough such that most of the reproductive stock can not migrate out of protected areas to be captured. We also need to consider larval transport and physical oceanography in the design of fishery reserves. Reserves must receive a regular supply of larvae from some spawning population, and they must be established in locations that will contribute to the downstream fishery. Reserve design should be developed in the context of metapopulation dynamics discussed earlier.

CONCLUSIONS

1. Research on queen conch continues to accelerate because of stock depletion throughout the Caribbean region and interest in stock rehabilitation. Recent advances are related to habitat requirements and survivorship of juveniles, larval ecology, fisheries oceanography, and certain management practices.

2. The majority of juvenile conch occur in a few unique habitats. These nursery grounds are defined by a suite of abiotic and biotic characteristics, including water circulation, patterns of larval accumulation and settlement, production of foods, and differential mortality. These nursery habitats must be identified and protected from destruction.

3. Stock enhancement through release of hatchery-reared conch has not been successful because of low growth rates and high mortality in juvenile conch. Release techniques are improving in parallel with good information on the variables that affect the highly variable mortality rates, but seed costs remain high, and hatchery-reared conch bear certain physiological, morphological, and behavioral deficiencies.

4. Recruitment to the juvenile class appears to be dependent upon the numbers of larvae supplied to the nursery grounds, on both spatial and temporal (interannual) scales. Locations with large populations of juveniles and adults receive regular deliveries of conch larvae in high density.

5. Populations of queen conch within the Caribbean region are probably interdependent because of larval drift on ocean currents for periods of time between two weeks and two months. The extent of interdependence among populations and among nations is poorly known; however, management of the conch resource must be considered within a metapopulation context. The significance of larval drift to fisheries management is an area of research that warrants much new research.

6. Successful reproduction of queen conch is related to adult density, particularly at low density. Although the lower threshold for normal reproductive behavior is unknown, density-dependent reproductive behavior has important management implications and should be explored.

7. Populations of queen conch significant to the fishery all occur within the depth range of SCUBA divers, consequently all conch are vulnerable to this form of fishing pressure. Given that relatively healthy populations of conch are now limited primarily to nations where SCUBA is prohibited in collection of conch, this form of management appears to have a positive effect.

8. Marine fisheries reserves can protect adult populations of queen conch and supply larvae to fished areas downstream from the reserves. Fishery reserves protect the integrity of spawner density for high reproductive efficiency and larval production. The size of reserves needs to be large enough to prevent the adult stocks from emigrating readily over the reserve boundaries, and the location should be chosen with the objective of producing larvae that will be carried to suitable downstream nursery areas.

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Table 1. Density of adult queen conch in the Exuma Cays Land and Sea Park near the island of Waderick Wells and in the fished area near Lee Stocking Island, Exuma Cays. Values for adult density are mean + SE for each depth interval. The Bank habitat was represented by a 5-km wide band of the shallow (0-5 m deep) Great Bahama Bank immediately to the west of the island chain. The Shelf habitats were to the east of the islands where depths increased gradually out to the shelf-break which began at approximately 30 m depth. [see Stoner and Ray, (1996) for details.]

Habitat/ Depth (m)	Fishery Reserve	Fished Area
Bank	53.6	1.7
Shelf		
0-2.5	0±0	0±0
2.5-5	34±22	2.2±1.7
5-10	49±18	7.2±4.1
10-15	270±85	60±47
15-20	104±58	88±32
20-25	148±72	18±9
25-30	122±70	0±0

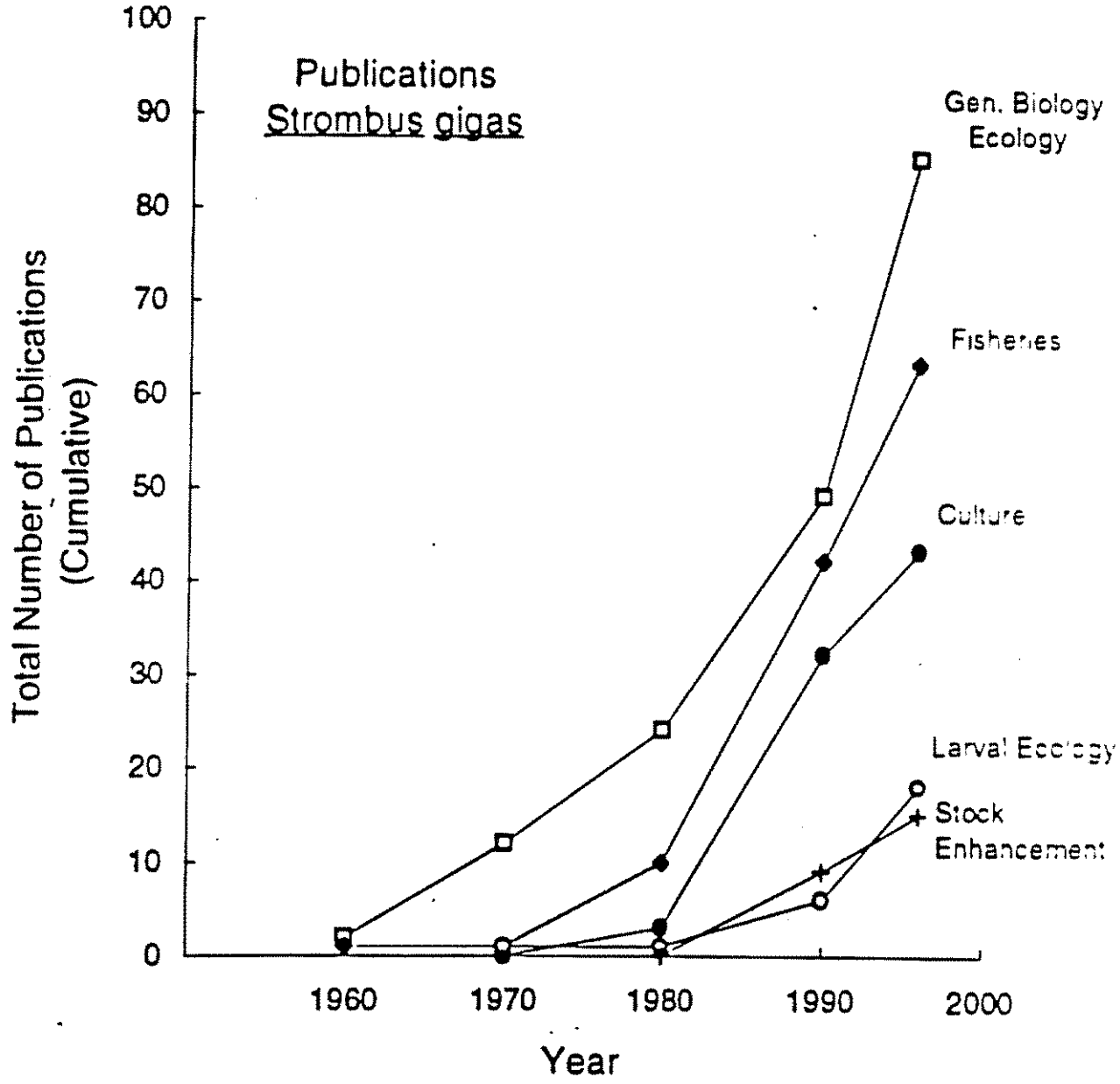

Figure 1. Cumulative curves for the total numbers of published scientific articles on queen conch by five subdisciplines.

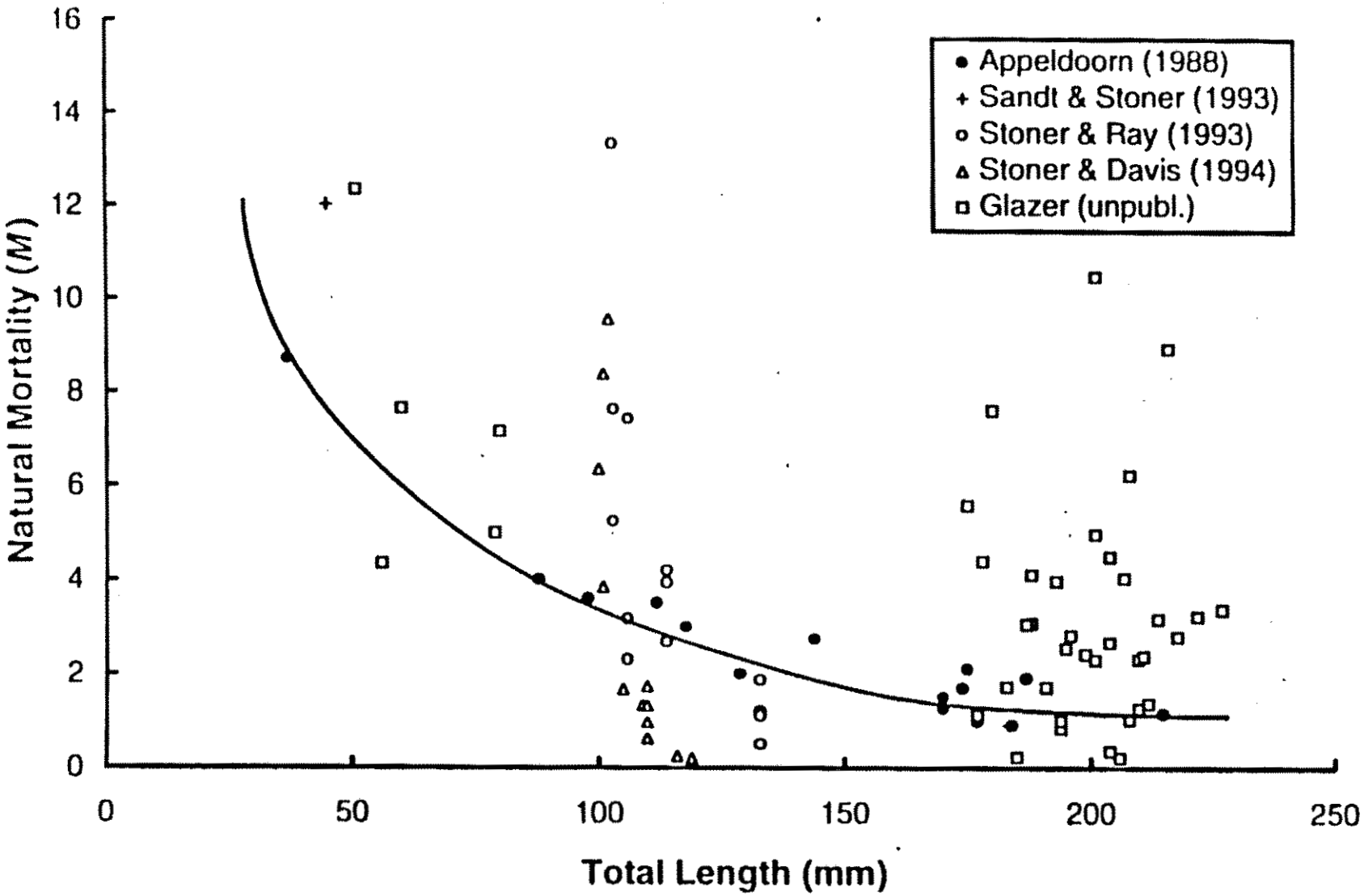

Figure 2. Variation in instantaneous rates of natural mortality (M) for free-ranging juvenile queen conch. The curve shown was adapted from data provided by Appeldoorn (1988) and is not intended to represent the points that are plotted for more recent investigations. (from Stoner and Glazer, in press)

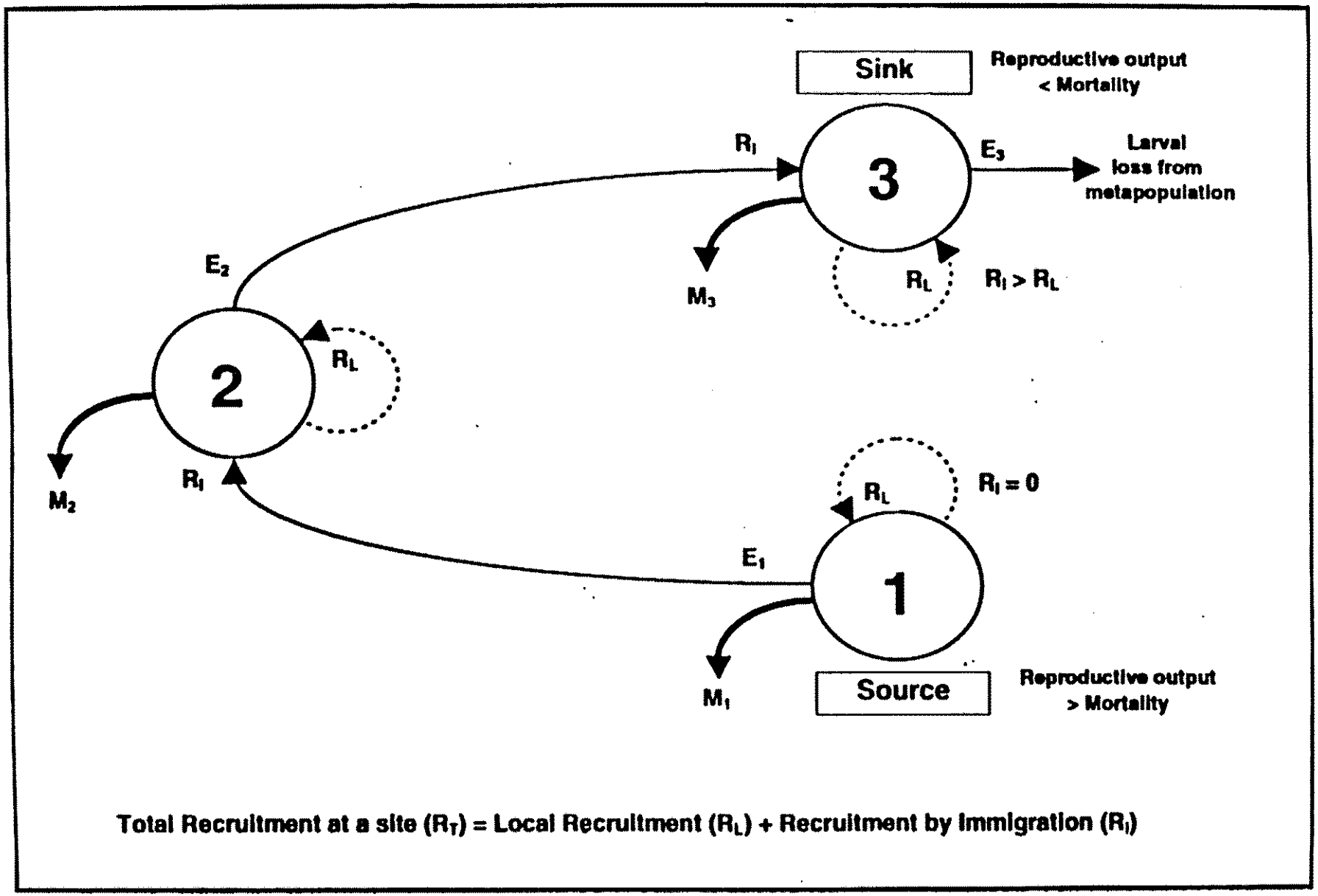

Figure 3. Conceptual model of metapopulation dynamics. The model assumes a general circulation of water carrying larvae from Population 1 to 2 to 3. See text for definition of the model parameters.

STATUS OF QUEEN CONCH FISHERY IN THE CARIBBEAN SEA

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INTRODUCTION

Management for the queen conch resource throughout the Caribbean is imperative. The need for management emanates from the level of fishing intensity throughout the region, the economic worth of the fishery, the biology of the species, the regional nature of the fishery and its trade, and the history of fisheries management in general, which is largely a record of failure. In considering management options, focus must be on robust strategies that are practical, both in theory and in practice. There are limits to the fishery that derive from limitations on the distribution of the species, limitation on its rate of productivity, and limitations on management policies due to the nature of the fishery. Lastly, any management plan must aim to be conservative. This arises from the large degree of uncertainty that exists (and will continue to exist) in our knowledge base. In effective management, uncertainty equals caution. This cannot be overemphasized.

The purpose of this review is to present the information detailing the need for management, and the limits to production and management options as outlined above. The review consists of four parts. First, the biology of conch will be reviewed, emphasizing aspects of production and distribution. Second, a brief review of the history and status of the fishery within the region is given, emphasizing the need for management. The third part looks at the stock structure and what is known about potential yield; that is, what is it that we are managing and how much can we take. Lastly, I will return to the biology of the species, emphasizing those aspects that directly affect particular management options and enforcement problems.

BIOLOGY AND LIFE HISTORY

Growth

The components of biological production are growth in size of the individual, mortality and reproduction. Conch grow in length only as juveniles. At the time of maturation conch cease growing in a spiral fashion and produce the flared shell lip characteristic of the species. Further shell growth occurs only as a thickening of the shell, especially the lip. Meat weight increases markedly during juvenile growth. However, within about a year of maturation meat weight ceases to increase, as all available energy goes into reproduction. It is suspected, though not well documented, that meat weight declines in very old conch as the decreased volume within the shell (due to shell thickening) can no longer accommodate a large amount of tissue.

Mortality

In assessing mortality, one must differentiate mortality due to fishing and that due to natural causes, primarily due to predation. Little quantitative information is available about natural mortality rates, particularly in adults. A composite description from many studies (Figure 1) indicates that the rate of natural mortality drops markedly over the entire juvenile and early adult life phase. However, there can be substantial variability in mortality rate due to aspects of habitat and/or social protection, at least within juveniles. Although the mechanism(s) are not clear, juvenile conch occurring in well-delineated nursery areas suffer a lower mortality rate that conch outside these areas. Because of methodological difficulties, no estimates of mortality have been made for older adults. Nevertheless, the mortality rate for these conch must be quite low as it is known that the potential longevity of conch is at least 20 to 30 years. Little is known about any aspects of the biology of conch older that about 12 years.

Few quantitative calculations of the rate of fishing mortality have been made. Nevertheless, it is clear that the rate of exploitation throughout the region is high (see below).

Reproduction

Conch mature at about 2.5-3 years of age, with age of first reproduction ranging from about 3 to 4 years of age. First reproduction occurs after the shell lip has completely formed and thicken to at least 5 mm. The sexes are separate and the ratio of males:females approximates 1. Conch mate by copulation. Thus, males and females require physical contact in order to reproduce. Frequent contact, when conch are at high density, is thought to stimulate an enhanced rate of reproduction.

The spawning season typically is about six months (Figure 2), although the actual time may vary with seasonal environmental conditions (e.g., temperature, sea conditions, frequency of storms). Furthermore, gametogenesis may occur throughout the year in some areas. Peak spawning usually occurs over a much shorter time period (about 3 months) with highest recorded rates of egg production occurring in July.

Females lay demersal eggs, and a single female produces many egg masses over the course of the spawning season. Studies on egg production show that, if food is not limiting, the average number of eggs/egg mass is 750,000, and each female would spawn 13 to 14 times per year, yielding a total of about 10 million eggs per year. The maximum rates recorded were 1.4 million eggs in a single egg mass and 22 million eggs in a season.

The benthic eggs hatch in about five days, releasing planktonic larvae. Larvae remain in the water for two to four weeks.

Migration, Dispersal, Distribution

Adult and juvenile conch are benthic and slow moving, with the degree of movement related to size. The highest recorded rate of movement for an adult conch was a displacement of 9 km over six-month period. Conch exhibit two types of migration. The adults have an inshore-offshore migration that is seasonal, and tied to reproduction. During the late spring, they will move into shallower waters for reproduction during the summer months, and move back to deeper waters during the winter. This migration may also result in a change of habitat, as conch prefer to spawn eggs on sandy substrata. There is also an ontogenetic

migration, that is, a migration that takes place as conch age from juveniles to adults. On average, conch move from shallower water to deeper waters as they age.

During the planktonic stage, larvae can potentially be dispersed over long distances. This offers the possibility of connecting otherwise spatially disparate populations through larval dispersal. While this potential is well established, actual rates of dispersal have not been measured and may be much lower.

The primary factors governing the large-scale spatial distribution of conch are water quality, depth, and habitat characteristics. In general, conch prefer areas of clean clear water. They also prefer areas of clean sandy sediment (with appropriate food), although adults can be found on a wide variety of substrata. They do not like muddy or turbid areas; thus, they are not going to be in areas influenced by high river runoff or sedimentation. Because conch are benthic grazers, they are limited to depths that are productive for benthic algae. The maximum depth under ideal conditions may be as much as 200 feet (60 m), but the majority of conch are going to be found in much shallower waters, certainly less than 80 ft (24 m) and probably less than 60 ft (18 m).

Given the above criteria, the places where conch will be found in large abundance are those that have broad shallow areas in clear water and sandy substrate supporting algae and sea grasses, as typified by The Bahamas, Turks and Caicos, Cuba, Pedro Bank, Honduras, the Colombian Banks, Belize, Chinchorro Bank (México) and the Grenadines.

STATUS OF THE FISHERY AND THE NEED FOR MANAGEMENT

Historically, the Grenadines, Turks and Caicos, and the Bahamas have been the important areas for conch production. These were later followed by important fisheries developing in Belize, Mexico and the Colombian banks. Mexican production rose rapidly and then declined; the fishery now is almost entirely closed. The most important area remaining is Chinchorro Bank, where fishing is restricted seasonally. Colombia's production rose and declined as well. Cuba is an interesting case because their potential markets, via distribution through Miami, are closed. Although they have exported conch to Martinique, a lot of Cuban production has been going into bait. At present, Pedro Bank is the most important source of conch production in the region, responsible for perhaps as much as 50%, or more, of the export market.

Throughout the region conch production is socially and economically important at a number of levels. Traditionally it is important for local use by the fishers themselves or their communities. Increasingly, conch production has become important for the tourist trade and as an export commodity. It is the development of the tourist trade over the past 30 years that has driven the high exploitation rates on conch. Increased familiarity and popularity have created the demand for exports. Chakallal, in his presentation, mentioned that an estimated worth for the fishery is on the order of $60 million (US). Furthermore, there is a multiplication factor indicating the added worth of the catch through processing and selling through the tourist markets, etc. Robin Mahon has estimated a multiplication factor of 7, which means that a $60 million fishery may be worth as much as $420 million to the regional economy.

There is a great deal of export and trade within the region and to external markets, much of it going to the markets in Miami, or at least through Miami. Turks and Caicos, Belize, México and Columbia export to Miami. Much of the Jamaican production goes through the Miami markets, but they have also opened new markets in Europe, exporting either directly or through Martinique. The export of fresh conch products is illegal in The Bahamas. In the Lesser Antilles, Martinique is an important market for conch for local French consumption. Most probably, all the neighboring islands, in some way or another are exporting their conch, either legally or illegally into the Martinique market, even from as far out as Venezuela. Bonaire and Curaçao are also important local markets, especially for conch fished from Los Roques, Venezuela. Often, such sub-regional trade is undocumented and unregulated.

Poaching, illegal fishing by one country in the territorial or EEZ waters of another, is another important component of regional trade. Understandably, there are few data on the extent of poaching, but it is believed to be extensive in some areas. In the Colombian banks there is poaching by neighboring Honduran and Nicaraguan fishers. Illegal fishing is felt also to be important between the Jamaican and Honduran banks, in southern Belize, and in the islands around Martinique.

In assessing the status of the fishery within the region, it is easier to identify those few places where there has not been overexploitation. This is not to say that all populations are threaten; one can have overfishing in terms of potential yield but still have a stable fishery in terms of maintaining some level of recruitment. Nevertheless, there are few fisheries that have managed to remain stable over a long period of time. One such fishery is that of The Bahamas. The fishery in the Turks and Caicos also seems to have been stable, but there is some indication that this fishery, too, may be overexploited, with fishers going further to fish and inshore stocks not recovering despite these shifts in areas of fishing. St. Lucia exports a lot of conch to Martinique and also has a local market, yet still has a quite viable population at the moment. Belize has been maintaining a substantial level of exports, although the level is much below the peak landings recorded in the early 1970's.

Despite these few exceptions, most places either have or have had a serious degree of overfishing. There were parts of Cuba, and also the Virgin Islands that were closed for five years; the fisheries of Belize and Colombia have declined markedly, and México's high production has since collapsed, with most areas now closed. The Los Roques archipelago in Venezuela is closed, and regulations have been put into place throughout much of the Lesser Antilles, especially in the islands of the Organization of Eastern Caribbean States (OECS). The worst cases occur in the Florida Keys and Bermuda, where there has been stock collapse, and unless something unusual happens, these populations may decline to local extinction. In Florida, the conch population is at least maintaining its low level, but there is no evidence of recovery despite 10 years of closure; in Bermuda there is little evidence of successful recruitment despite an equally long closure. In both cases, however, in addition to overfishing, there are serious impacts to habitat quality.

POTENTIAL YIELD AND STOCK STRUCTURE

In assessing the potential yield and stock structure of conch, I want to give emphasis to the limits to our knowledge and the impediments in trying to calculate how much can we take

from an area, i.e., what might be a sustainable yield. Fisheries scientists attempt to understand the dynamics of populations through the application of simplified mathematical models. With respect to conch, there are severe limits to how far this approach can be taken. For example, a basic fishery model such as yield-per-recruit, requires separate measures of growth, natural mortality, fishing mortality, etc. Conch have a basic growth pattern where the shell grows spirally as juveniles, but once they mature they produce a the flared lip. Further thickening of the shell occurs over time, but conch no longer grow in length after maturation. This creates a problem because juvenile growth is measured one way (shell length) and adult growth is measured another way (shell thickness). To obtain overall growth, these two measures must be combined. This is not simple (though not impossible), but it is not something one can do for an individual conch; it can only be done for an average conch in a population. Thus, what can be generated is an average model, without accounting for individual variability. Obtaining information on mortality is even more problematic, because age information is needed, and age determination usually comes from growth analysis. In fact, all other processes associated with production, such as fecundity, are somehow related to growth, either through size or age effects. Further complicating analysis is that conch growth, morphology and production are habitat dependent, so specific model parameters developed from one area may not apply to another area perhaps only a few kilometers away. Thus, even if all the necessary parameters could be estimated there is limited geographical space for which that model could apply if you are trying to be very specific; as a result, a generalized approach must be taken. With mortality, not only has a generalized model been the best that has been produced to date, the model is further limited to early ages when growth can be measured. This model shows mortality to decline rapidly with age through maturation; this leads to further complications when dealing with models that assume constant mortality.

Production models are more simplistic, requiring only information on catch and effort. However, these too have problems, and there are very few places that have the kind of data required. To my knowledge, the only place that has substantial data is Turks and Caicos. Thus, limited data, both in quantity and quality, restrict this approach.

Nevertheless, there is a role for generalized models in examining the effects of fishing and potential management strategies. For example, one important benchmark for assessing the degree of exploitation and potential management measures is the Spawning Potential Ratio (SPR). This compares the ability of an exploited population to produce eggs relative to an unexploited one. The ratio reflects the degree of increased survival of eggs necessary to maintain a stable population. Thus, when SPR falls to 20%, a population only has 20% of the spawning capability that it had when it was unfished, and average survival would have to be five times as great to maintain the same abundance. That is, this degree of survival is necessary to compensate for the extra mortality caused by fishing. To calculate SPR you need to know fishing mortality, natural mortality, size or age-related fecundity, and the percentage of females that are mature. Shown in Figure 3 is an example of SPR calculations for a single site in Puerto Rico under three different management scenarios. The results indicate that size limits or the limitation of harvest to mature adults helps conserve SPR, which otherwise falls to dangerous levels at realistic levels of fishing mortality.

If the modeling approach is limited, another approach that can be utilized is to monitor catch levels and monitor abundance. As an example of the former, Figure 4 shows the catch from Puerto Rico from the 1970's to 1986. During the 1970's catch was fairly stable. After this came a short period when there was a large increase in production, followed by a large and sudden decline. Catch rates subsequently remained low. This is a fairly typical pattern around the Caribbean. Looking back, it is easy to see that Puerto Rican production went beyond what could be sustained. However, the relatively stable production in the 1970's might be indicative of what could be sustained from the fishery, and this indication may be as equally valid, or more, than results from incomplete analyses of maximum yield or other modeling results.

Another potential approach to indicate stock status is to compare estimates of stock abundance or density among lightly and heavily fished areas. Table 1 shows estimates of density from various surveys. Estimates vary from a high of almost 300 conch/ha for unfished portions of Pedro Bank, down to 1 or 2 conch/ha in Florida and less than 1 conch/ha in Bermuda. The problem with comparing these estimates is that they are calculated on the basis of the entire shelf, i.e., the estimated number of conch is divided by the area of the entire insular or continental shelf, and shelves differ in quality of habitat. As a result, the numbers are not directly comparable between areas unless the habitat distributions and spatial scales are also similar. Nevertheless, large differences in density are probably indicative of differences in stock status.

An extension of the above argument is to compare estimates of potential yield (on an areal basis) among areas. However, in this case the data are quite limited, with only three values available: Puerto Rico - 0.55 kg/ha; Turks and Caicos - 1.4 kg/ha; and Pedro Bank - 2.3-3 kg/ha. Each estimate was derived using a different methodology and all have a large, but unknown degree of associated variability. Thus, these estimates are not statistically significantly different. Comparing these values also entails all the pitfalls associated with comparing densities (e.g., habitat distributions). The estimate for Pedro Bank was based on an approximation formula using density estimates. In calculating this estimate, some assumptions were made in applying the models, and if different assumptions were chosen, one could easily result in a yield estimate similar to that for Turks and Caicos or, in fact, lower. The estimate for Turks and Caicos was derived from levels of sustained production over long periods of time, however, there is now some doubt about whether this level of production is, indeed sustainable. My conclusion is that average maximum production is on the order of about a kilogram per hectare, but there will be susbstantial variation in this depending upon the extent and characteristics of the area being considered.

Stock structure is an important management consideration for conch because the species is suspected of being particularly susceptible to recruitment overfishing (i.e., overfishing to the point where successful reproduction and replenishment is inhibited). Stock structure will be determined by degree of larval dispersal and connection among areas. Again, this is an area where there exist few and inconclusive data. There are two interrelated approaches to looking at stock structure: larval dispersal and genetic comparisons.

Conch larvae are planktonic for two to three weeks, and larvae have been found to disperse great distances. However, the relative extent of this long distance dispersal is unknown. From a managerial point of view, a few individuals dispersing across areas is not

really important. Work on genetic variations show that, with the exception of Bermuda, the Caribbean may constitute a single genetic population. However, there are two qualifiers to this analysis. First, only a few individual larvae need to disperse among areas within any generation to make those areas appear similar from a genetic point of view, but this degree of dispersal is negligible from a managerial point of view. Second, there are other processes besides reproductive isolation that can make stocks appear similar on a genetic basis. One such process is post-settlement selection. This renders initially divergent genetic populations to appear similar because of similar external pressures causing differential survival. Thus, with the exception of Bermuda, the genetic data are inconclusive.

Given the relatively short planktonic life and the complex current patterns that exist within the region, it is believed that stock structure can be fairly localized. This view has been supported by limited larval sampling, which shows larval densities decreasing markedly away from source areas. Throughout the Caribbean there are large series of eddies or gyres that can act to keep larvae in a general vicinity for a sufficient time to recruit within localized area. The spatial extent of this is unknown, but a radius of 10 to 100 km would seem a reasonable guess. It is only in the western Caribbean, near the Yucatán Strait and in the Florida Strait where the Caribbean current really becomes constrained to flow through narrow passes that the current speed is high and one can expect a significant degree of long distance dispersal during the larval period. Thus, while there may be some exceptions, the general conclusion is that stocks should be managed as if they were self-recruiting.

EFFECTS OF BIOLOGY AND FISHERY ON MANAGEMENT OPTIONS

Up to this point, I have reviewed the basic biology of conch and the history of its exploitation, emphasizing the need for management. This was followed by a review of our knowledge of productivity and stock structure, emphasizing the limitations we have in our understanding of these. Lastly, I want to review some potential management measures in light of the biology of the organism and how this might affect a particular measure or the enforcement of that measure.

Minimum Length

Size limits based on shell dimensions are intuitively appealing because each conch is handled individually and, hence, its size can be assessed prior to harvesting. Thus, there would be no mortality of undersized conch using this approach.

Juvenile conch grow in a spiral pattern, getting longer as they age; but at maturation, they put out the flared lip. Thereafter, the only growth is a thickening of the shell; length no longer increases. This means that the length of the conch is fixed at maturity. If a legal minimum size limit is set above the size of maturity, the conch will never become large enough to reach that limit, and hence will not be harvestable. If the limit is set below the size of maturity, all conch will be subject to exploitation as juveniles.

Conch show two types of length variability: variability in mean length within an area, and variability in length among areas. The analysis of spawning potential ratio shown in Figure 3 shows that with respect to the first source of variation, a size limit may preserve SPR to some degree at high fishing mortality. This result holds when considering many different

areas, although the range of variability in length will be greater. However, spatial differences in mean length will lead to significant spatial differences in the measure's impact, with implications to both the species and the fishery. Figure 5 shows the mean lengths and ranges from a number of sites around Puerto Rico. Mean lengths range from less than 20 cm to over 24 cm. If the minimum size limit is high, the result will be that areas characterized by smaller than average conch will be effectively closed, causing displacement of fishers and fishing effort. If the limit is set low, then all conch are exploited as juveniles, some for a substantial period of time thus defeating the purpose of the size limit in the first place. Biologically, minimum size limits have a tendency to genetically select for conch of small size. However, if length of conch in any given area is controlled by habitat conditions (as suspected, but no specific data are available), closure of local populations due to overall small size may result in conserving genotypes for large size. If the opposite is true, then a minimum size limit would accelerate the selection against large sized individuals.

Minimum Weight

A corollary or substitute for length is weight. In conch, weight is primarily determined by the length at maturation, although there is some weight gain after maturation. The first problem in using weight is defining what the standard measure of weight is, i.e., to what degree is the meat processed before weighing. For example, Table 2 gives data from Pedro Bank in terms of how many conch constitute either kilogram or pound. Depending on the degree of processing, the result varies by a factor of 2 or more.

If the intention is to use weight as check on length (that is, the fishers assess length, but compliance is based on weight), there must be a way to convert length to weight. The conceptual approach is to define a length, and then find its corresponding mean weight from a length-weight regression. In practice, however, there is considerable variation in weight about any given length, with half the individuals falling below the mean weight. To allow for this variation, the weight must be averaged, such as number of conch/kg (e.g., Table 2) or number of conch per volume.

The relationship between length and weight in conch differs for juveniles and adults and differs among areas. If the size-based measure is to allow fishing of both juveniles and adults, then the measure should be based on the juvenile length-weight relationship. To partially overcome the effect of spatial variations in length-weight relationships, conch from a variety of areas should be included when calculating the relationship.

Harvest of Adults

At the time of sexual maturation, conch produce their flared shell lip, which subsequently thickens over time. As such, maturation state, and the potential for reproduction can be assessed using the shell lip. Conch can potentially copulate and spawn when their external reproductive structures (verge in males, egg groove in female) are fully developed. This occurs when the shell lip has obtained a thickness of about 5 mm.

A potential management measure, thus, is to restrict harvest to sexually mature adults. This can be assessed by fishers through examination of lip thickness (Figure 6) prior to harvesting. Compliance can be checked either by measuring the shell (if landed) or by examining the unprocessed meat to determine if the reproductive structures are fully

developed. The latter may alleviate imposition of unpopular regulations requiring landing conch in the shell in those fisheries where conch are taken from the shell either underwater or on the boat. The analysis of spawning potential ratio (Figure 3) showed this to conserve SPR even at high fishing pressure.

Closed Seasons

Closed seasons can serve a variety of management objectives, e.g., reduce effort, facilitate reproduction, increase safety with respect to seasonal sea conditions). A closed season tied to reproduction is a management measure readily understood, and therefore often accepted, by fishers. Conch have a broad reproductive season: from April through October is fairly characteristic. However, the period of peak spawning activity is much narrower, encompassing fully the months of July and August (e.g., Figure 2). Thus, one of the management options available is a closed season during the peak of the reproductive season. In addition to allowing reproduction and reducing effort in the normal sense (i.e., restricting fishing time), this option offers some additional advantages in effort reduction. Because conch typically migrate to shallower waters to reproduce, and because they usually seek an open sandy area to deposit eggs, conch are more available and more visible during the spawning season, and hence more vulnerable to fishing at this time. Closure during the spawning period helps reduce this vulnerability.

Closed Areas

There are three options for closed areas that ought to be considered: nursery areas, spawning areas and marine reserves. The latter will be treated separately. In shallow, seagrass habitats at least, nursery areas are located in very special sites. They are found along flow paths that have access to incoming planktonic larvae. They are located where the substratum is of the appropriate type, in terms of sediment characteristics, sea grass density, and where there are high rates of benthic algal productivity. Areas with all these properties are very localized and very special. In addition, there seems to be an important effect of abundance of conspecifics (i.e., other conch) that is important. Survival is higher if there are lots of other conch; if the nursery area is fished out, it is going to detract from future recruitment success. For these reasons (habitat protection and maintenance of juveniles) nursery areas ought to be protected. Because these areas are shallow, they are also near the coast and potentially threatened by environmental disturbance from shore-based activities and freshwater discharge. Thus, protection should not just be from fishing, but from any kind of coastal environmental damage as well. Recruitment of conch also occurs in deeper water, but much less is known of this process in terms of its spatial or temporal consistency, habitat characteristics, or population dynamic effects.

Considering spawning areas, there is some evidence that there is a critical density of adults necessary for reproduction and recruitment, that is, spawning stocks at a high density have enhanced rates of reproduction. Thus, maintaining areas of high density of adults can have an additive effect increasing the probability for successful reproduction and subsequent recruitment. Recruitment studies in The Bahamas and Florida have clearly shown the recruitment of juveniles in nursery areas is directly related to the larval supply. In many parts of the region, the only remaining concentrations of adults are found in deep waters. It is clear

that large deep water areas previously unexploited, such as Pedro Bank, must be a source of larvae on a very large scale. To what degree such an area is seeding other areas is not known. The deep areas acting as refuges for conch and potential sources of larvae to seed shallow areas are increasingly being subjected to fishing as stocks in shallow areas have declined.

Marine Reserves

Marine reserves are areas where any form of extraction is prohibited. Marine reserves are a very important management tool that should be incorporated into any management plan. While the typical notion of closed areas, such as areas containing nursery sites or spawning stocks, can be incorporated into a reserve, the concept of marine reserves has broader management objectives. Protected areas act as an insurance policy or buffer against management and environmental uncertainties that could lead to management failure. I have tried to stress the relative high amount of uncertainty that exists, and will continue to exist, in our knowledge of the species and our ability to manipulate its system of production and its fishery. Marine reserves also provide control areas against which to assess the impacts of fishing on a larger scale. Comparisons of fished and unfished areas provide a more fundamental and robust system to assess the effect of fishing relative to simplified mathematical models based on limited data. In setting up marine reserves, an attempt should be made to have all components of the production system protected (nursery areas, spawning areas and the ontogenetic pathways between the two) and that there be a replicated system of such reserve areas. Conventional wisdom suggests that up to 20-30% of the fishery areas should be so protected. It is understood that under current management scenarios, this degree of closure may not be practical in the short term, but the need for this in the long term must be clear and planned for.

Gear Restrictions

Almost all conch are harvested by diving. The principal gear is for compressed air: Scuba and Hookah. In many areas, such as here in Puerto Rico, a ban on compressed air diving would stop the fishery. In other areas (e.g., Belize, Turks and Caicos, The Bahamas, Los Roques), there are still broad expanses of shallow waters that could be used. The issues affected by restriction of these gears are diver safety and protection of possible deep water refuges for spawning stocks. In most shallow and heavily exploited areas it is uncertain if there also exist deep water stocks and whether these are important for maintaining overall recruitment. There is good evidence that this is the case in The Bahamas, and there are indications that this is the case in Belize as well. Deep water areas surrounding Chinchorro Bank are also being exploited, now that the shallow conch population on top of the bank has been reduced.

The potential problem in maintaining a deep water stock through a restriction on scuba is illustrated by the case of Martinique, which has little shallow area and has laws banning the use of Scuba for any fishing. The fishery for conch there is intense, and densities in shallow areas are low; yet, due to the ban on Scuba there is an extensive population of adult conch in depths greater than 80 ft (24 m). What is not clear is whether there is any recruitment to that deep water population. That is, all the conch may be settling in shallow water and being caught before they mature and migrate out to deep waters. What results is a kind of gauntlet

effect. If Scuba is banned, a deep water population can be protected, but it can only be maintained in the long term if there is recruitment of new individuals from shallow areas, and these individuals must survive the gauntlet of fishing pressure.

Quotas & Limited Entry

There are no biological constraints or ramifications to the use of quotas or limited entry as management measures. Limited entry effects the fishery significantly with respect to its economic and social characteristics. Limited entry should improve the economic standing of the fishers, because the more fishers involved in the fishery, the further the economic benefits from the fishery must be divided. In theory, limited entry also will increase the conservation ethic among remaining fishers, as they will have a greater financial stake in a continued healthy fishery.

Annual quotas are difficult to apply because of the need to have the landings statistics in real time to be able to assess if the quota has been reached. There are but few places where such ane appropriate data collection system is present. Trip quotas are more plausible, as compliance can be checked in the field or at the dock, or through market records.

SUMMARY

I have tried to show that there are biological limits to production, distribution and management, and that uncertainties are, and will be, characteristic of our knowledge. Furthermore, the biology of conch is such that it is very vulnerable to overexploitation. It is a shallow water species, slow moving, that comes into clear areas to reproduce, and reproduction requires high density. The high potential for collapse is an issue of paramount concern; thus management should be cautious and conservation oriented. This is more evident still in light of the historically poor record for management - for all fisheries, not just for conch. This is not to say that we have not had some success, but the successes have not been keeping pace with the increase in fishing pressure. Marine reserves, in particular, offer a buffer in this regard. Given the uncertainties that exist, it is unreasonable to expect that a complex management plan can be developed that will optimize all components of the fishery. On the contrary, there are some fundamental management measures, based on biology and fisheries practices, that are robust in supporting longterm sustainability. In the end, the basis of production (reproduction, nursery and other critical habitats) must be protected, and fishing effort must be controlled.

There are reasons to be optimistic that meaningful management can be achieved, but it will take work. The experience in Jamaica may be taken as an example. Jamaica recently developed a management plan for conch fishing on Pedro Bank. Getting to that point was not easy. The initial problems that needed to be overcome included little to no data, an already intensively exploited fishery, and no existing legal framework for adopting a management plan. Yet, through a spirit of cooperation among the government and industry (perhaps with incentive coming from the need for CITES export permits), a research survey was conducted and a management plan was mutually agreed upon that called for substantial reductions in the catch. While this degree of progress is a cause for optimism and a model

for other areas, it is still too early for celebration. The success of any management plan will be measured by the long term sustainability of the fishery.

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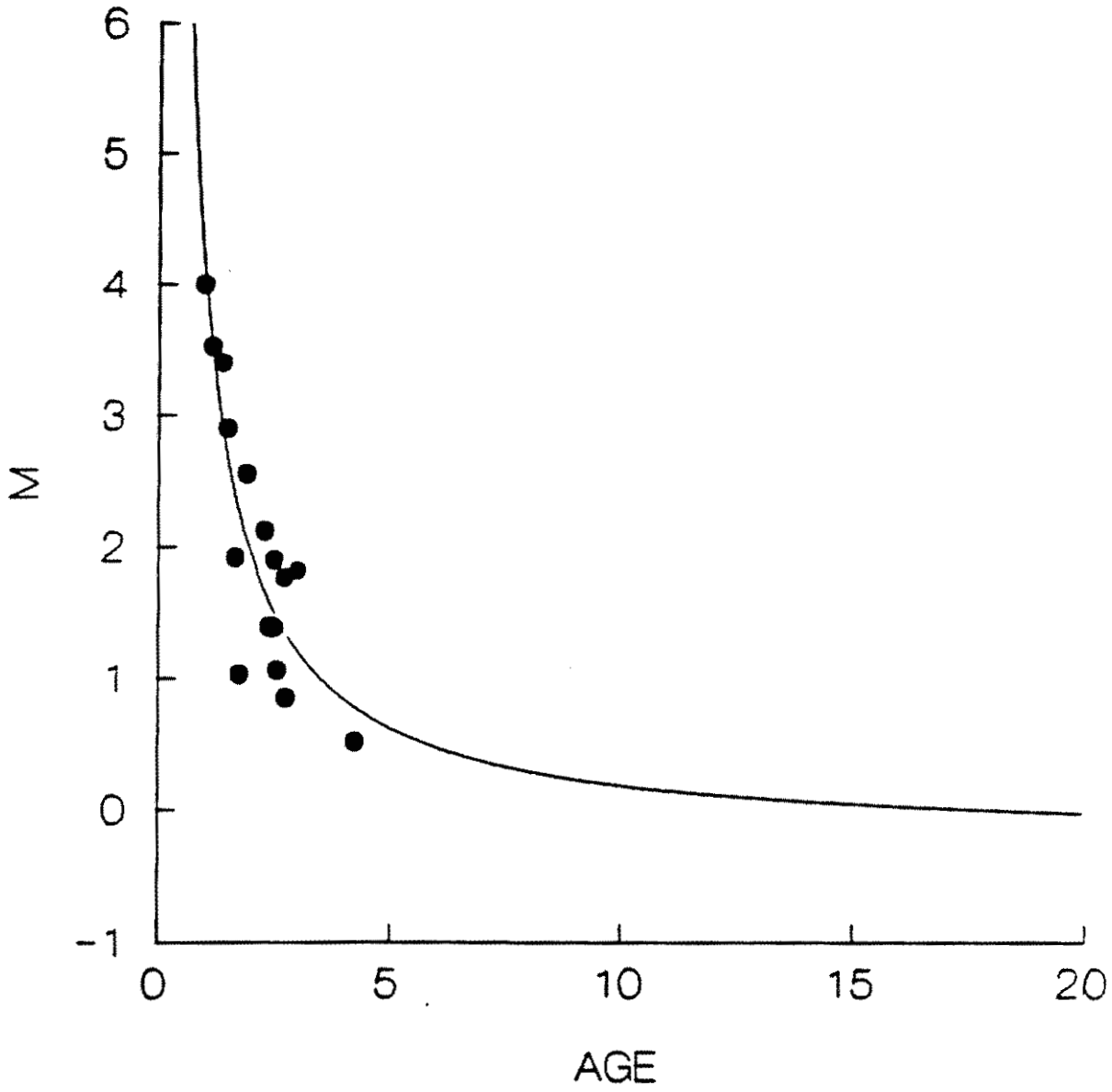

Figure 1: Instantaneous rate of natural mortality (M) as a function of age for *Strombus gigas*.

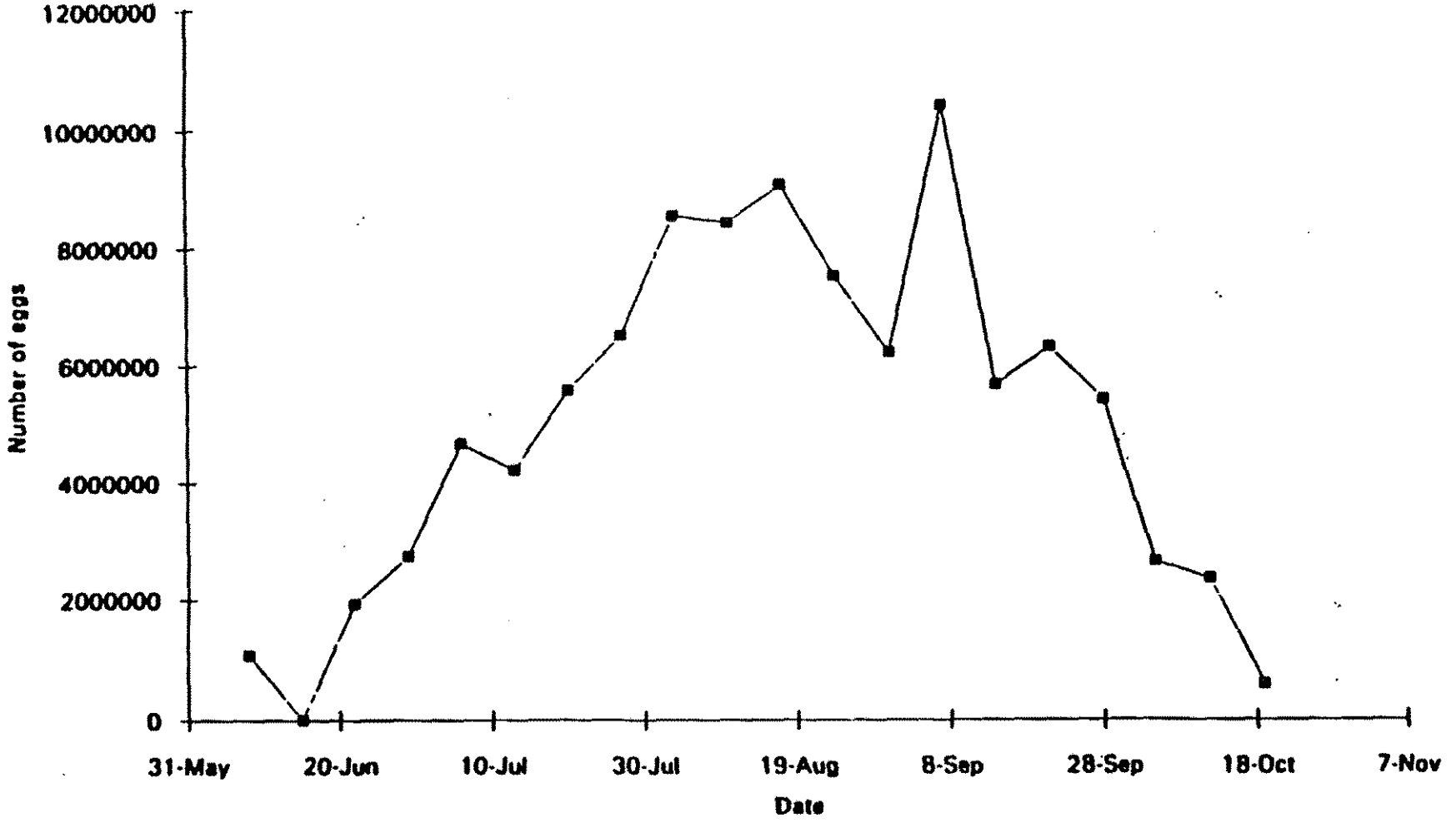

Figure 2. Total number of eggs produced per week during the course of the reproductive season by 10 *Strombus gigas* held at a density of 1/70m^2. (From Appeldoorn 1993).

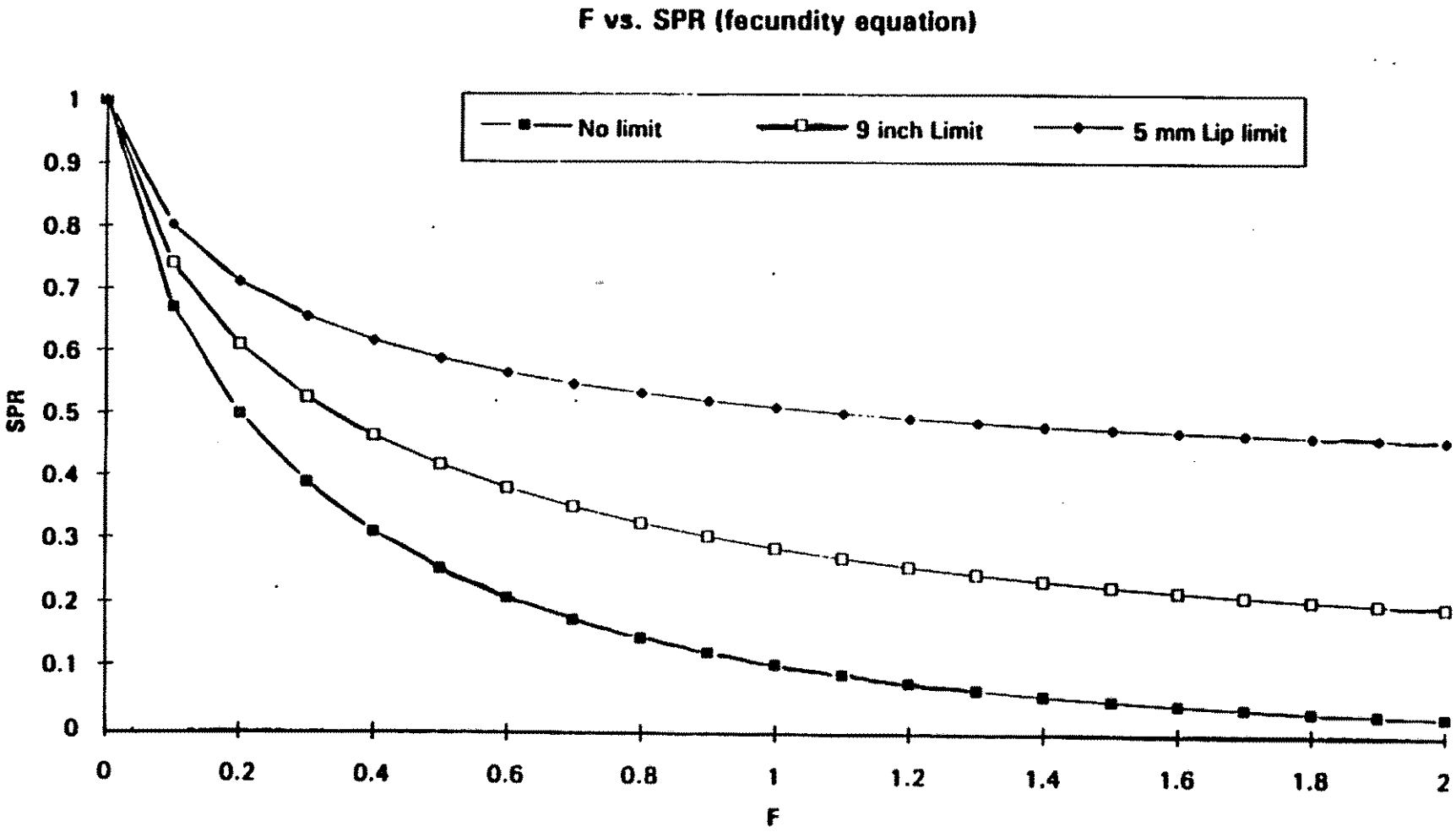

Figure 3. Spawning potential ratio (SPR) versus fishing mortality (F) for Strombus gigas under three different management strategies (no minimum size limit, 9-inch (23-cm) minimum shell length, 5-mm minimum shell-lip thickness) with an assumed age-fecundity relationship. (From Appeldoorn 1993).

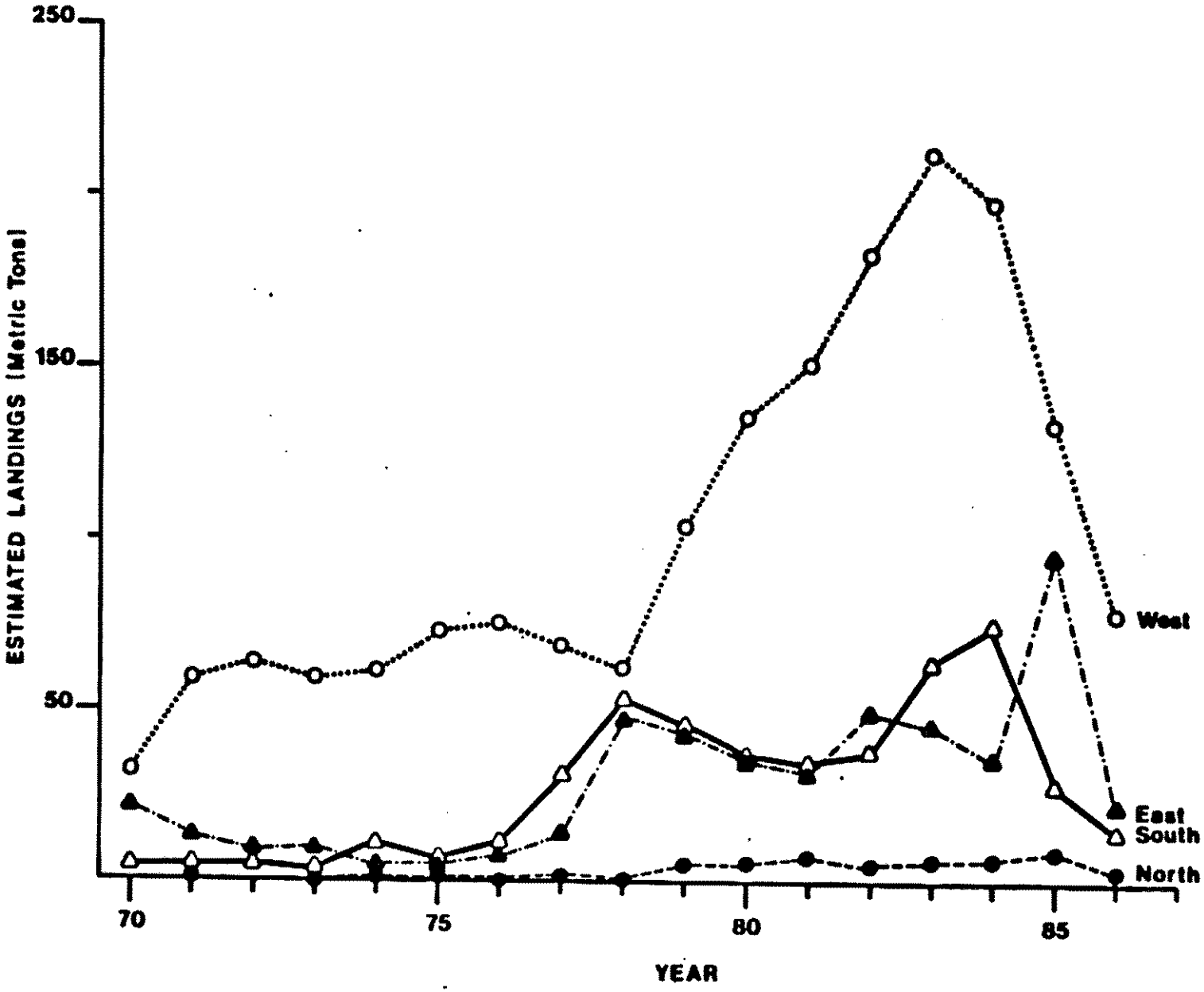

Figure 4. Estimated commercial landings of queen conch in Puerto Rico by coast. (From Appeldoorn 1991).

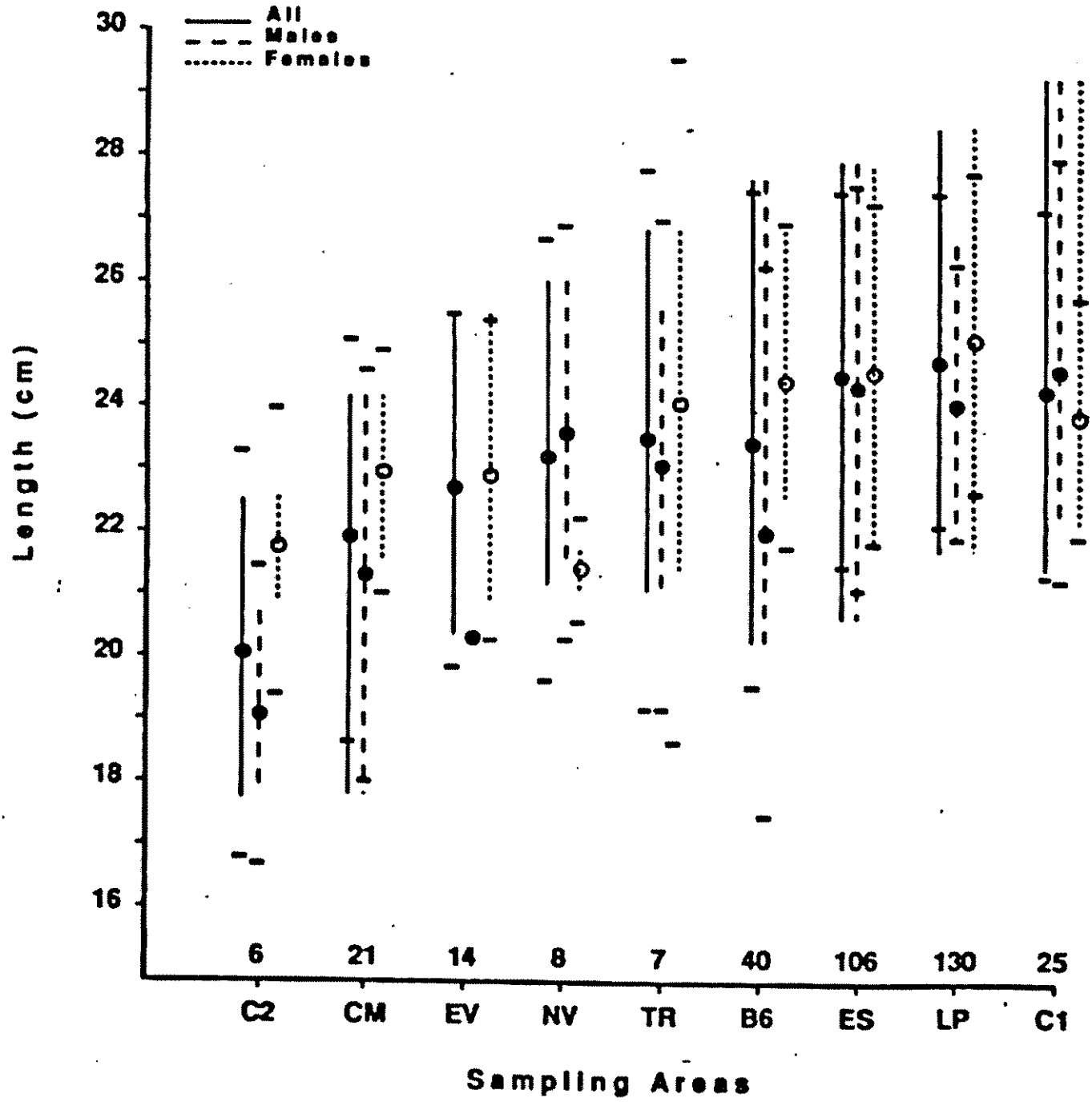

Figure 5. Length distributions of adult *Strombus gigas* from different areas of Puerto Rico. N = sample size. Site codes: LP = La Parguera, CM = Caja de Muertos, ES = El Sico, TR = Tourmaline Reef, B6 = Buoy 6, NV = North Vieques, C1 = Culebra1, C2 = Culebra 2, EV = East Vieques. (From Appeldoorn 1994).

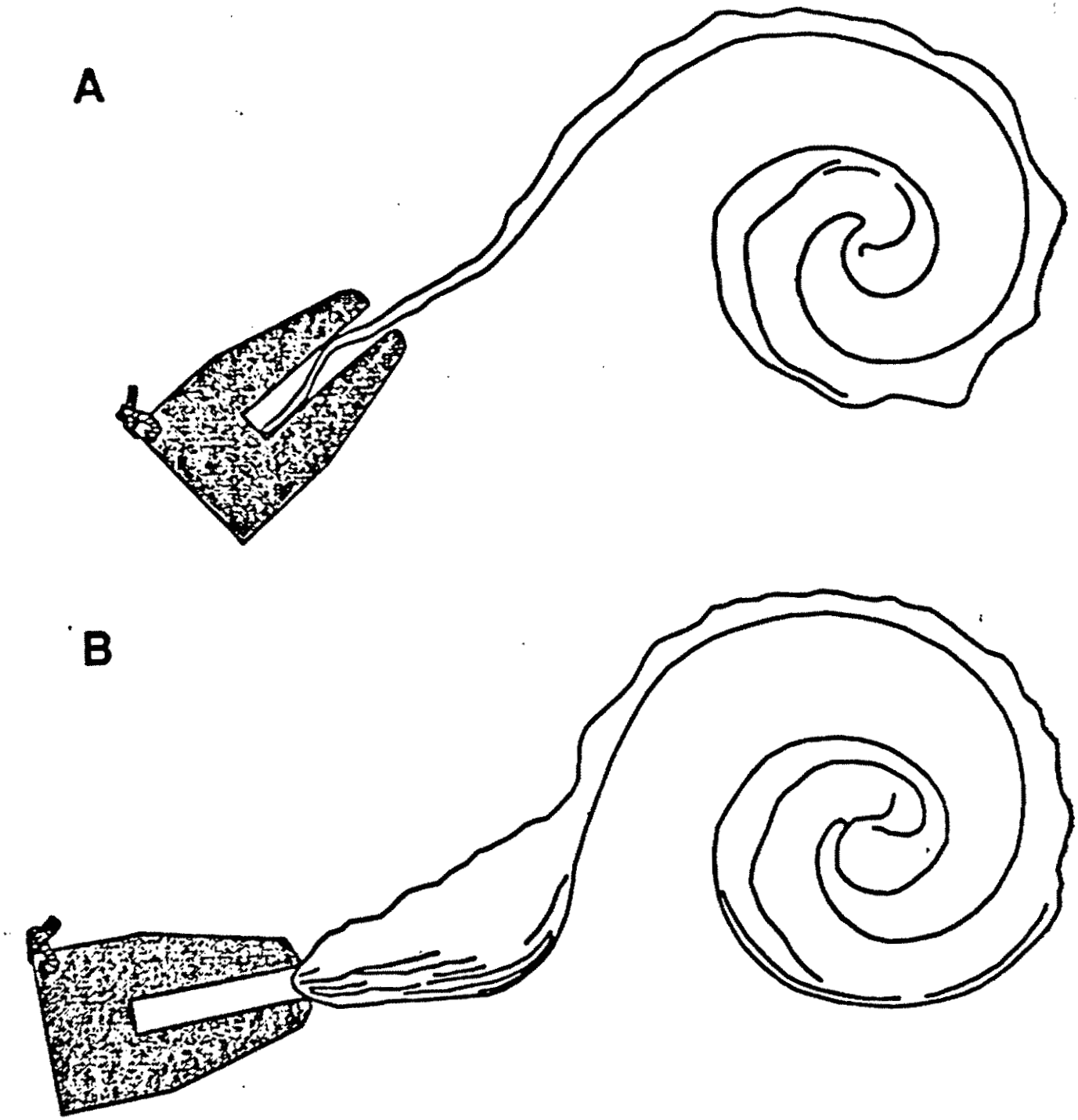

Figure 6. Assessment of sexual maturity in *Strombus gigas* using lip-thickness. Top: Cross-section through the shell of a maturing individual. The newly flared shell-lip is thin and can fit completely within the 5-mm measurement gauge. Bottom: Cross-section through a mature adults. The measurement gauge cannot fit over the thickened shell lip. (From Appeldoorn 1994).

Table 1. Average densities of *Strombus gigas* determined by resource surveys. (From Appeldoorn 1995).

Location	Density (No./ha)	Reference
Pedro Bank		
Artisanal Zone (0-10 m)	89.09	Appeldoorn, 1995
Industrial Zone (10-20 m)	144.46	Appeldoorn, 1995
20-30 m	276.97	Appeldoorn, 1995
U.S. Virgin Islands		
St. Croix	7.60	Wood & Olsen, 1983
St. Thomas/St. John	9.70	Wood & Olsen, 1983
St. Thomas/St. Johns	12.25	Friedlander et al., 1994
Puerto Rico	8.11	Torres Rosado, 1987
The Bahamas		
Little Bahama Bank	28.50	Smith & Neirop, 1984
Great Bahama Bank		
Unprotected Bank	20.79	Smith & Neirop, 1984
Protected Bank	53.60	Stoner & Ray, in review
Protected Shelf	96.00	Stoner & Ray, in review
Florida Keys		
1987-88	2.40	Berg & Glazer, 1995
1990	1.54	Berg & Glazer, 1995
Bermuda		
1988	0.52	Berg et al., 1992a
1989	2.94	Berg et al., 1992b

Table 2. Number (N) of individuals per kilogram (and pound) of queen conch from Pedro Bank by degree of processing. (From Appeldoorn 1995)

Processing	N/kg	N/lb
Unprocessed	6.6	3.0
50% Cleaned	7.7	3.5
65% Cleaned	9.9	4.5
85% Cleaned	12.1	5.5
100% Cleaned	14.3	6.5

Source: Tewfick, personal communication.

THE QUEEN CONCH FISHERY IN THE CARIBBEAN - AN APPROACH TO RESPONSIBLE FISHERIES MANAGEMENT

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INTRODUCTION

The utilization of the meat of queen conch (*Strombus gigas* L.) as food and its shell for artifacts and ornaments goes back to pre-Colombian times. From these origins until recently, the queen conch was harvested by artisanal fishermen mainly for local consumption and limited inter-island trade. However, within the past 20 years, a sizable commercial fishery has developed as a result of an increasing human population, the migration of Caribbean people to North America and the growth of the tourist industry. Now, the queen conch represents one of the most valuable demersal resources in the region and is second only to spiny lobster in fisheries value to the Caribbean region. It was estimated, based on reported landings that approximately 6,000 mt of conch meat may be harvested from the region each year, and this figure does not take into consideration the unknown quantity used for local consumption and extracted by poachers. Applying an average wholesale value of US$ 10/kg to the known harvest results in an overall value of the Caribbean fishery of US$ 60 million. This estimated value of the fishery could, however, be multiplied several fold due to the jobs created in the processing and marketing of conch meat and ornaments particularly through the tourist and restaurant trade. In addition, the conch fishery provides valuable jobs and its high market value makes it an important source of foreign exchange through export or domestic sale to the tourist industry.

The largest single producer of conch is Jamaica, which exported 2,051 mt of conch meat in 1995, valued at US$ 10.6 million (Smickle 1995). The conch fishery is one of the major foreign exchange earners for that country, earning more than the lobster fishery. Jamaica's 13 conch processing plants employ approximately 531 permanent workers and 749 temporary workers. In Cuba, a significant portion of the catch of 1,500 mt is used for bait, representing a substantial loss of potential income (Appeldoorn and Rodríguez 1994). The recorded landings of other countries fishing for conch are substantially lower than these two, with the next highest national landings being approximately 500 mt per annum (Table 1).

DISTRIBUTION AND HABITAT

The queen conch is generally distributed throughout the shallow waters of Bermuda and southern Florida, the Caribbean islands, Central America and northeastern South America to Brazil, but is not found south of the Orinoco River in eastern Venezuela. They are found in clear waters associated with sandflats supporting seagrass beds and algal species where conch obtain both food (macroscopic and unicellular algae and detritus) and shelter. Older conch may be found in coral rubble and gravel substrates away from seagrass beds. Conch are found in depths ranging from shallow subtidal waters to 76 m. However, densities decrease significantly below 30 m due to light limitations for plant growth (Randall 1964).

STATUS OF STOCK

Although not threatened with extinction, the queen conch has been placed on the World Wildlife Fund Red Book as commercially threatened, due to heavy fishing pressure which has resulted in drastic declines in natural populations in most fishing areas. The queen conch has been placed on Appendix II of the Convention of International Trade in Endangered Species (CITES), which lists species in danger of possible extinction. CITES requests importing countries to ensure that each shipment of conch is certified by the Scientific Authority of the exporting country so as not to endanger the conch population. CITES was concerned about the level of export of conch from Jamaica and requested a management plan for the species for that country. The plan was submitted to CITES which made it possible for exports to continue (Smickle 1995). Accessibility, ease of harvest and high demand have resulted in generally fully-exploited or overfished conch stocks (Table 1).

The resource is harvested mainly by divers (free, SCUBA and HOOKAH) using small boats. In the Bahamas, HOOKAH equipment and in Dominica, gillnets are also used. In some countries such as Belize, Colombia and Martinique, SCUBA is prohibited. In Jamaica, industrial size vessels (20-35 m) are used on the Pedro Banks. Twelve such vessels were licensed in 1995, most of which were leased from the Dominican Republic, Honduras, Nicaragua, and the USA. Some divers on these commercial vessels use SCUBA gear. The vessel's crew usually consists of eight persons but this number could increase to 36 if divers and canoe operators ("dorimen") are included. Each trip, averaging 1-1½ months, can land an average of 13,600 kg of meat (Smickle 1995).

As can be observed from Table 1, the status of conch stocks is variable in that some areas like Saint Lucia have unfished populations while others areas such as Martinique, Cuba and Turks and Caicos, the resource is heavily exploited but not threatened. Overfishing is also apparent in many areas such as Colombia, Florida, México, Puerto Rico, St. Thomas/St. John (US Virgin Islands) and Venezuela.

BIOLOGY AND MANAGEMENT

At the time of sexual maturity, conch cease to grow in length and produce a characteristic flared shell-lip. This begins to occur after three years of age. Tissue growth continues at this time, although at a reduced rate, and shell growth continues as progressive

thickening of the lip. It requires five to ten months from the on-set of lip flaring for the conch to be sexually mature.

Reproduction occurs by internal fertilization throughout most of the year, February-November (Berg and Olsen 1989) but is at the greatest intensity during the warmer months, April-September (Randall 1964; Stoner et al. 1992). The sex ratio is generally accepted as 1:1 in non-breeding aggregations. Sexual dimorphism exists where females are approximately five percent larger in shell length and 21 percent heavier at an age of three years. Males possess a verge (penis) and the females a genital groove.

Spawning occurs two to three weeks after copulation with the females producing an average of eight egg masses a season, each averaging 300,000 eggs, with as many as 750,000 being produced on occasion. Eggs hatch after approximately five days and two to five weeks later the larvae settle on suitable substrate and begin their benthic life. Juvenile conch spend much of their first year as substrate infauna, feeding epibenthically at night. Although conch have the potential for tremendous reproductive output, there is very little knowledge on larval transport and recruitment variability over the region. Until there is a better understanding of stock-recruitment relationships and the relative importance of larval drift versus larval retention, one should assume that conservation of local stocks will enhance local abundance. While regional action is desirable, management must start at the local level.

Conch management, as is the case for most fisheries in the region, has been constrained by a lack of reliable data and information about the status of the resource, the importance of larval drift and retention, and the inability to establish and adequately enforce regulations for its conservation. Although several countries have management regulations (Table 1), they are often not enforced. Several management strategies have been attempted but there is little or no evaluation of their success. Management regulations implemented within the region include closed seasons and areas, minimum shell length and meat weight, the landing of the whole animal, and the prohibition of harvest of juveniles and use of SCUBA gear.

SOME PRINCIPLES IN THE HARVESTING OF LIVING MARINE RESOURCES

The status of the queen conch fishery is not unique and world-wide many marine fisheries are in a very poor state, with over-exploited resources, declining returns for those dependent on the resources for a livelihood, and over-capitalization. In 1991, in response to these problems, the FAO Committee on Fisheries (COFI) requested the establishment of a new set of principles or approaches which would result in the establishment of sustainable and responsible fisheries. This call was reinforced by the Cancún Declaration arising from the International Conference on Responsible Fishing held in 1992 in Cancún, México and by the UNCED Summit in Rio de Janeiro in 1992 where the world community adopted Agenda 21, Chapter 17 of which deals with oceans, coastal areas and their living resources. This drive continued through three major initiatives. The first two were the adoption in November 1993 of the Agreement to Promote Compliance with International Conservation Measures by Fishing Vessels on the High Seas, as part of the process of elaboration of the Code of Conduct for Responsible Fisheries, and the adoption in August 1995 of the UN Agreement on the Implementation of the Provisions of the 1982 Convention of the Law of the Sea related to the provisions on Straddling Fish Stocks and Highly Migratory Fish Stocks. Finally, the

FAO Conference in October 1995 adopted the global Code of Conduct for Responsible Fisheries. The Code is particularly pertinent to this meeting on queen conch fisheries, since it promotes the principles of sustainability of living marine resources and their environments and the precautionary approach to management, while taking into consideration biological, political, economic, social and cultural realities.

These moves both encourage and reflect an international awareness of the need to alter drastically the historical exploitative attitude to living marine resources and to replace it with practices that encourage sustainable and optimal approaches to these invaluable and irreplaceable resources. The declarations, agreements and Code all provide a framework for responsible fisheries which is generally accepted by the governments of the world and the many diverse groups with interests in fisheries and the stocks upon which they depend. If appropriately applied this framework should result in sustaining the stocks and the ecosystems in which they are embedded in healthy and productive states. It should be a very useful exercise, as this International Queen Conch Conference deliberates on the species and the fisheries which utilize it, to examine briefly some of these approaches, particularly as contained in the Code of Conduct, and their implications for managing the queen conch fisheries of the Caribbean area.

Long-term sustainability

It is generally accepted that states and all users of living aquatic resources have an obligation to conserve these resources and the ecosystems in which they occur, in order to optimize returns for the present users and to provide all possible options for future generations. This obligation underlies the Code of Conduct for Responsible Fisheries and the many other international steps that have been taken in recent years. Clearly, this goal of sustainable utilization is not easy to attain in highly variable stocks interacting with complex and usually poorly understood ecosystems and affected by fisheries which are, themselves, driven by complex forces of demography, local and global economics, societies and politics. In the case of the queen conch, sustainable utilization has to be practiced in the face of considerable uncertainty about many biological features of the stock or stocks, including abundance in most areas, growth rates, natural and fishing mortality rates, recruitment processes and others. In addition, there are 20 different states fishing for what is probably a single stock and, within most if not all states, the fisheries are made up of a range of types from artisanal to highly industrial, with a host of intermediates.

Acceptance of the Precautionary Approach to Fisheries (FAO 1995) is implicit in the Code of Conduct, and the steps necessary for responsible fishing when confronted by complexity and uncertainty are well described in the Guidelines to the Precautionary Approach to Fisheries. These Guidelines emphasize that sustainable utilization requires the application of prudent foresight and suggest that this includes, amongst other attributes, the following:

1) The avoidance of changes that are not potentially reversible;

2) The prior identification of undesirable outcomes and of measures that will avoid them;

3) That any necessary corrective measures are implemented without delay and are rapidly effective;

4) That where there is uncertainty, primary attention should be given to conserving the productive capacity of the resource;

5) That the fishing and processing capacity should be in harmony with the production potential of the resource, to avoid continual social and economic pressure to over-exploit the resources in order to utilize this capacity; and

6) That all fisheries should be conducted according to an explicit and appropriate management plan and that the administrative and legal framework exists to ensure implementation of the plan.

These themes, and others, are also picked-up in the Code of Conduct for Responsible Fisheries which urges States to apply the precautionary approach using the best scientific evidence available, including stock specific target and limit reference points, and what actions should be taken if the points are exceeded. Of these, (1), (2) and (4) refer more specifically to the resource and require good insight into the status and dynamics of the resource. The avoidance of irreversible changes and prior identification of undesirable outcomes, and identification of uncertainty, presuppose a certain level of knowledge of the resource. In addition, point (4) stresses that where there is uncertainty, the doubt should be used in favor of the resources.

In the case of queen conch, a considerable amount is known about its general biology and ecology, as presented in the brief summary at the start of this paper. There have been a number of good studies on the species in general and on its occurrence, dynamics and fisheries in specific regions. Its general distribution is reasonably well known and its growth rates, reproductive biology and ecology, feeding biology and ecology, levels and causes of natural mortality, as well as the general level of exploitation throughout its range have all been studied with considerable success (Berg and Olsen 1989; Table 1). However, despite this progress, and in keeping with many fish stocks around the world, there are still several key uncertainties in existing knowledge of the resource, which need to be considered in its management, and which require consideration of the principles of the Precautionary Approach. The most important uncertainties would appear to be the following:

1) The detailed stock structure of the resource;

2) The actual fishing mortality and effort on the resource in many parts of the region;

3) The mean age at first-capture and variability about that;

4) The distribution of larvae and hence about the origins of recruits to local areas;

5) The inter-relationships and movements between conch in the deeper water and shallow water; and

6) The locality of nursery areas for the non-planktonic juvenile stages.

Of these, probably the most important from the point of view of sustainable utilization are those referring to the stock structure and sources of recruitment. If there is a single stock throughout the region, then local depletions are less serious, in that recruitment from distant areas can replenish these areas if fishing mortality is reduced, and there is little or no loss of genetic diversity. In other words, as long as the biomass of the total stock is at a level where future recruitment is not endangered, the changes are unlikely to be irreversible. However, if recruitment is derived largely from the immediate vicinity or, even more extreme, if there

are genetically isolated local stocks, local depletions may not recover and may involve loss of genetic diversity. Under such circumstances, changes would not be reversible. In the case of such doubts, clearly the precautionary approach requires that management must be based on the assumption that there may be a number of localized stocks and that local depletions must be avoided. In other words, conch populations in each of the major fishing areas and grounds must be treated as if they are a stock in themselves and each unit managed on a sustainable basis.

The other uncertainties should be treated with similar caution. Where there is uncertainty about the actual fishing mortality and its relationship to the level which can be sustained by the local stock, the fishing effort should be constrained at its existing level, and not allowed to increase unless there is clear evidence that the resource can sustain it. Conversely, if there is evidence of over-exploitation, appropriate steps to correct this must be taken as soon as possible. Similarly, there have been suggestions that deep-water refuges, where SCUBA fishing is not practiced, provide a reservoir of spawning stock that can sustain recruitment when the shallow water densities have been reduced to low levels. In view of the uncertainty about the inter-relationships between deep and shallow water components, this should not be used as an argument for allowing excessive reductions of density in shallow water, until the movements have been quantified and until there is proof that these deep water refuges will serve this function.

The locality of nursery areas is an important consideration for the conservation of the queen conch. Identification of the areas would enable the establishment of reserves to ensure sufficient survival of juveniles to maintain the desired level of adult biomass. The use of reserves, for both adults and juveniles, would seem to have the potential for an important role in queen conch conservation. The sedentary nature of adults and nonplanktonic juveniles would enable the protection of reserves of biomass which could supply surrounding areas with larvae. However, the positioning and size of such reserves would have to be designed to take cognizance of the actual dispersal patterns of the species. If recruitment is, in fact, localized, then reserves would have to be closely spaced in order to replenish large areas. Enforcement of a large number of small reserves could be problematic unless the local fishers and interest groups were firmly behind the approach.

Balancing potential effort with productivity of the resource

A number of countries appear to have taken steps to ensure that fishing effort on queen conch is restricted to appropriate levels. Berg and Olsen (1989) reported that Venezuela, Belize and Bonaire had systems of limited entry and licensing. Jamaica has also introduced a limited entry system into its queen conch fishery and no new licenses are currently being issued (Smickle 1995). Some other countries such as Colombia and Cuba have limited effort through the use of closed seasons, many other countries have included an option for closed seasons in their management plans, while others have opted for systems incorporating closed areas, such as the Bahamas and Venezuela. México has opted for annual quotas by areas and closed seasons.

A decision on how best to manage fishing effort needs to consider the biological, social, economic and political realities of each specific case and is likely to differ by country.

However, there does appear to be widespread and growing awareness of the fact that open access systems, even if the resource is protected by other means such as closed seasons or areas, are highly likely to lead to economic problems, including waste of labor and capital and depressed incomes (Pearse 1994). In order to avoid these problems, an appropriate system of limited access is required, in which a number of fishers or fishing units are licensed to fish for queen conch in the EEZs of each state. This number should be such that each participant can expect a reasonable return on their investment and labor without endangering the stocks. By extension, the total effort within the region should similarly be balanced for the species production throughout the region.

In those states that already have excess effort, this will require some very hard decisions on who should be excluded and who granted access. However, failure to take such decisions will ultimately lead to all or most ultimately loosing the benefits they currently enjoy, as the resource is depleted to non-productive levels. Again, such decisions will have to be made by each state with due consideration to its unique circumstances. However, the Code of Conduct for Responsible Fisheries does stress that due recognition should be given to the needs of indigenous traditional fishers and to local fishing communities which are highly dependent on fish resources for their livelihood. An operational interpretation of these requirements is that a previous history of fishing should normally be a major consideration in claiming a right of access.

The sedentary nature of queen conch could lend itself to the adoption of approaches incorporating community-based management or even territorial use rights to fish, or TURFs (Pearse 1994). The advantages of giving long-term rights of access to the resource, with an associated greater sense of responsibility for its optimal use, to specific communities or co-operatives could well lead to improved sustainable use of the stock. A key question here, however, is again the detailed stock structure of the resource. If recruitment to localized aggregations is dependent on a regionally distributed stock, then there will be less scope for localized management, and regional cooperation and management strategies will be essential. If, however, there are local, self-sustaining stocks, such localized management and the development of community-based management approaches could be feasible.

Transparency, consultation and joint decision-making

Arising from the above considerations, it is clear that any decisions made on the future management of queen conch will have potentially far-reaching implications for the resource itself, for all those who depend on the resource for their livelihoods and for those who have other serious interests in the resource. It is important to recognize that a failure to take decisive action will have equally profound consequences. As such, it is critical that any decisions are made with the full knowledge of all the interest groups and are made following consultation and input from them. The ideal would be to arrive at a management policy that has the full support of all the interest groups. Such an ideal may well be unattainable, but this should not prevent efforts to arrive at consensus or as close to it as possible.

This international queen conch meeting may be seen as a step in that process. It will need to be followed up by consultation at the national level with the fishers, the fishing industry, the processors and marketers, tourist groups, conservation groups and others as required.

The purpose of these consultations will be to reach agreement on the objectives for the fishery and on the best means to achieve these management objectives, facilitating the development of national and regional management plans. These consultations will probably need to be accompanied by educational and awareness building campaigns to make people aware of the issues and possible strategies for optimizing the fisheries.

It is clear that there is also an urgent need for regional cooperation and consultation on the management of this regional fishery, if real progress is to be made in sustainable utilization of the species. Therefore these national consultations and the establishment of national objectives and management plans should be followed by a regional forum of responsible authorities to establish international approaches as necessary. While it was stated above that the resource should be managed in the form of localized stocks, these local stocks may still transcend national boundaries in many cases. For example, Mahon (1990) suggested that states sharing the same island-shelf should manage their queen conch resources jointly. In addition to this, there should be a regional management strategy for the resource, including the sharing of information and, wherever possible, the adoption of uniform management measures. For example, if it is biologically feasible to have the same minimum size, or the same closed season for the whole region, it should make enforcement much easier.

This regional cooperation and joint management will require on-going meetings and cooperation between the states with interests in the queen conch resource. This is strongly urged within the Code of Conduct for Responsible Fisheries. Such cooperation and joint management will probably necessitate the establishment of a regional conch management organization or arrangement. The exact nature of the organization or arrangement, hereafter referred to as an arrangement, will have to be settled by the states themselves, but all states with interests should have representation within the arrangement and, where interested states are not members, they should be encouraged to become members. Members of relevant governmental and non-governmental organizations should also be allowed to attend meetings related to the arrangement and should have access to the records and documents relating to it.

Management objectives

Effective management is only possible when clear objectives are established and a critical end-product of the national and international consultations and meetings should be a set of generally agreed upon objectives. One such objective is the long-term sustainability of the resource. The round of consultations described above should enable identification of the desired national objectives, and the next step will be to determine appropriate management plans to achieve these objectives, or come as close as possible to realizing them without exceeding sustainable exploitation rates. UNCLOS and all relevant instruments stress the need to base management measures on the best available knowledge of the state of the resource and its potential productivity or the effort that it can sustain. Based on this principle, the most appropriate approaches to regulate and manage the fishery should be determined. Again, this International Queen Conch Conference should play an important role in the initial collation of the best available knowledge.

The objectives, national and regional, need to consider, amongst others, the following points:

1) Whether the stock, local or regional, is under-, fully-, or over-exploited and hence whether there is a need to reduce or an opportunity to increase the yield from the stock. Where there is sufficient knowledge, a target reference point suitable for conserving the stock (such as $F_{0.1}$ or $f_{0.1}$), and an appropriate harvesting strategy such as a constant catch or constant escapement should be identified. The strategy selected should also take cognizance of the social and economic objectives listed below and should reflect both the status and dynamics of the resource and the desired nature of the fishery;

2) Open access or limited access and, if the latter, how it is to be implemented and how much effort will be permitted in the fishery? In the absence of better knowledge, it may prove desirable, for example, to freeze effort at its current level until better stock assessment information is available. While this could be a national decision, if any one or more states decide to retain an open access approach, this could lead to a spill-over of surplus effort, possibly through poaching, into adjacent states. This would clearly be undesirable;

3) How the access should be allocated and, for example, the relative importance given to artisanal, commercial, recreational or other fisheries;

4) Whether the fishery should target a high quality product designed for export, such as was suggested as one objective for the Lesser Antilles states by Mahon (1990), whether to prohibit exports as in the Bahamas (Table 1) or whether to focus on the bait market, as occurs in Cuba (Table 1). In principle, each state should be free to make these decisions for itself, provided that they do not jeopardize the regional management by, for example, allowing animals smaller than the regional size limit to enter the regional market, thereby making enforcement more difficult;

5) The need for measures to protect critical habitats, such as seagrass beds for juvenile conch. Here it will be necessary to ensure adequate measures at the national level but also to ensure that, collectively, the regional protection is adequate for the species as a whole;

6) If either a fishing practice or the status of the resource or local stock is considered to be detrimental to the ecosystem as a whole or to be threatening biodiversity in any way, then overcoming these problems needs to be identified as an objective and the steps to correct these impacts should be identified and implemented; and

7) Whether there are exceptional circumstances that require emergency action to alleviate the problem, such as a dangerously low abundance of animals in an area, which may require the prohibition of fishing for conch. These decisions could be made at a national and bi- or multi-national level.

Additional objectives may also be identified at national and regional level. Again, there should be national objectives, which need to be drawn up within the context of the regional objectives, and regional objectives which incorporate, as far as possible, the sets of national objectives. Clearly this requires an iterative process. In this process, individual states must accept that some compromise may be necessary where sets of national objectives are in conflict and consequently threaten the attainment of regional objectives. In addition, the set of objectives needs to be reviewed and revised as necessary through the same processes, typically every three to five years.

Formulation of a management plan

The selected objectives and the means to achieve those objectives form the core of a management plan. The objectives will only be attained if the steps necessary to achieve them are adequately implemented and enforced. The issues of implementation and enforcement should be considered at the time of identifying the objectives and any objectives which are clearly impractical to implement or enforce should be discarded. For example, if the necessary capacity to monitor the resource, monitor catches of individual quota holders and enforce quotas does not exist within a state, then total allowable catch (TAC) should not be used as the mechanism to control fishing mortality. Similarly, as an example, the establishment of large numbers of small closed areas in isolated areas which cannot be patrolled, would not be appropriate.

Consultation and joint decision making should also be the means by which the objectives are translated into a management plan. The biological, ecological, social and economic implications of different options should be evaluated, and the costs and benefits of the different options, in these same terms, should be considered.

The management plans, both at the national and regional level should include the following aspects:

1) Clear identification of the geographical range of the management plan;

2) Details of the states and/or the interested parties who are part of the management plan;

3) The duration of the plan in its existing form and when it will be reviewed;

4) The agreed objectives for the resource and fishery;

5) Details on critical stages in the life cycle of the queen conch and the general status of the stock (regional or local);

6) Details on the access rights granted, including the number of parties with access, the conditions associated with access and the duration of the access rights;

7) List of the fishery regulations. These could include:

a) allowed fishing gear; b) vessel specifications; c) minimum size; d) details on closed seasons; e) complete specification of closed areas; and f) any restrictions on sale or export, etc.;

8) Details on any steps being taken to protect or restore habitats important to the conservation of the species.;

9) Details on the data that will be collected to monitor the fishery and the status of the resource, how those data will be analyzed and how the management plan will be altered according to the results. For example, if the length of the closed season will be dependent on the status of the resource, details should be provided on exactly what indicators of its status will be used, how these will be estimated and how they will be used to determine the length of the season;

10) The methods for control and surveillance of fishing, processing and selling operations, including details on responsible authorities and the assets that will be utilized;

11) Details of the legal framework supporting the management plan and the penalties for infringement; and

12) Specification of the participants, arrangements, structures and responsibilities for ensuring on-going consultation between the management organization, or arrangement at the regional level, and the various interest groups.

The management plan as listed above may appear to be an arduous and bureaucratic statement, of limited value. However, it has several important functions. The first of these is that it forms an effective contract between the interested parties and the states responsible for management of the resource and fishery. The agreed terms and approaches are explicitly listed so that all parties are fully informed on their rights and responsibilities. Secondly, it serves as a vital means of communication. It is highly unlikely that all members of the interest groups will be present at all steps in the consultation and decision-making process. The management plan serves as a means of informing them of the agreement of which they are a part. Where the literacy level of members of interest groups will prevent their being able to read and comprehend the plan, the national management plans, and the regional management arrangement, should incorporate steps to disseminate the information in a more appropriate manner. As with the objectives, the management plan needs to be evaluated, reviewed and revised as necessary every three to five years.

Data collection and research

The likely success of a management plan for queen conch will be directly related to how much is known about the resource and its dynamics. In accordance with the precautionary approach, the less certainty there is about these factors, the more conservative should be the approach, in order to provide a buffer to protect the resource and fishery in the event of incorrect knowledge or unexpected events.

It is therefore in the interests of all the interest groups that rigorous monitoring of the abundance of the resource, including changes in distribution and size or age structure, and the dynamics of the resource such as trends in its growth rates, reproductive characteristics and mortality rates, are adequately monitored. This will require the timely collection and analysis of appropriate data at the level of the local stock. Similarly the characteristics and behavior of the fishery and the market should be closely monitored to evaluate whether the management plan is proceeding as intended and to monitor the status of the fishery and its impact on the resource. All these will require the existence of well-trained, experienced and equipped staff both in the field to collect the data and in the laboratory to analyze and interpret the data.

Much of this will happen at the national level and the states with an active queen conch fishery are responsible for its responsible execution. However, these data should also be examined and analyzed at a regional level and the proposed regional arrangement will need to be responsible for that. It is important that there is agreement within the region on the data to be collected and the format in which it is to be collected. The indices measured and the methods of measurement should be standardized within the region to facilitate comparison and joint analysis of data collected. The various states should share their data and information on the queen conch fishery freely, in order to facilitate and encourage regional perspectives on the fishery.

Implementation

Finally, of course, the management plan needs to be effectively implemented. In the case of queen conch, where there is considerable concern about its status in much of the region, the plan also needs to be formulated and implemented as quickly as possible. It should not be unreasonable to suggest a regional meeting of the states involved in queen conch fishing to meet in 12 months time to review and discuss the proposed national management plans, developed in the interim, and to agree formally on regional plans and strategies.

The pre-requisites for the successful implementation of the national and regional management plans have already been discussed. The states must ensure that they have the necessary research and administrative capacity to undertake the formulation of management objectives and the plans required to achieve those objectives. The states need to ensure that the legislation necessary for implementation is in place, or can quickly be enacted. They also need to ensure that they have the capacity for effective monitoring of the stock or stocks and the fishery, and for control of the fishery, including enforcement of regulations.

The above will all require commitment of personnel and facilities, which will cost reasonable amounts of money. It is highly likely that shortage of funds will be seen as a reason why the necessary steps cannot be taken. However, it needs to be recognized and accepted that, in a fishery reportedly worth approximately US$ 60 million and the second most important fishery in the Caribbean, urgent steps should be taken to ensure that a small but adequate percentage of that $60 million is utilized to ensure the resource upon which this income depends is adequately conserved and that the fishery is managed and executed in a manner which yields the greatest benefits to the participating states and to the region as a whole.

CONCLUSIONS

1) The low abundance of the queen conch in many parts of the Caribbean is cause for considerable concern and urgent steps are required to protect the resource and the livelihoods of those who are highly dependent on it.

2) Generally there is considerable knowledge available on the biology, ecology and dynamics of the queen conch, and this should be used as a basis for management action while additional knowledge is gained and accumulated.

3) Despite (2) above, there are also important uncertainties in our knowledge of the resource and these require actions based on conservative assumptions, in keeping with the Precautionary Approach.

4) In particular, it must be assumed that local aggregations of queen conch, on scales no larger than the island-shelf and, in some cases, at a smaller scale than that, are self-sustaining populations and possibly isolated stocks. Therefore management efforts must be aimed at maintaining densities of animals in all these local aggregations at densities adequate to ensure their sustained productivity.

5) Deep-water aggregations cannot be assumed to be reserves of spawning biomass to replenish shallow water areas, at the current level of knowledge.

6) The use of marine reserves, distributed with frequencies appropriate to the dispersal distances of planktonic larvae, for both adults and settled juveniles, have an important role to play in queen conch management. These reserves must enjoy the support of local fishers and other interest groups.

7) While socially and politically a difficult option, systems of limited access to the resource are inevitable if the queen conch resource is to be conserved and continue to support a socially and economically valuable fishery. The traditional and historic rights of fishers need to be considered in developing an access rights system for each state. The sedentary nature of the resource means, if recruitment is predominantly local, that community or cooperative based management approaches could be applicable where appropriate.

8) Management of any fishery has serious implications for all interested parties. It is essential that management of the queen conch proceeds with full participation from all recognized interest groups, including the fishers.

9) In view of the need to manage queen conch at the level of local aggregations, much of the responsibility for management will rest with individual states. However, there is much to be gained from close regional cooperation, and it is recommended that a regional management organization or arrangement is established to coordinate and facilitate exchange between the national management organizations

10) Sets of national objectives need to be developed as soon as possible with the participation referred to in (8) above. These objectives should encompass biological, social, economic, marketing, environmental and other key concerns.

11) In addition to national objectives, regional objectives should also be developed. These will encompass the national objectives although, in some cases, there may be a need for compromise at the level of the national objective in order to develop a coherent and effective regional set of objectives.

12) Similarly, at both the national and regional levels, management plans need to be developed to identify and describe the methods used to achieve the objectives. These management plans should include details on the stock (at the required scale), the duration of the plan and how it will be reviewed, the access rights and fisheries regulations, approaches to monitoring and control and all other actions and requirements for successful attainment of the objectives.

13) It is recommended that draft national objectives and management plans are developed over the next 12 months, using the best available information, and then tabled at a formal regional management meeting for the development of a regional strategy for optimal management of queen conch.

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Table 1. Summary of queen conch (*Strombus gigas*) fishery in the Caribbean region.

Country	Landings mt (year)	Density (Conch/ha)	Stock Status	Regulations*/Comments
Antigua and Barbuda	69 (1994)	n/a	Overexploited	225 g meat; 180 mm shell. Option for closed season.
Bahamas	410 (1991)	20.8-28.5[1] 53.6-96.0[2] (protected area)	Overfished only in localised areas	No exports of meat. No juveniles. Closed areas.
Belize	149 (1994)	n/a	Overfished. Peak production of 562 mt in 1988	180 mm shell; 86 g clean meat (removal of gonads, operculum and mantle). Closed season - 1 July-30 September. SCUBA prohibited.
Bermuda	Fishery closed in 1978	0.52-2.94[3]		Fishery closed in 1978 as a result of low populations.
Colombia	400 (1990)	n/a	Some areas overfished. Peak production of 800 mt in 1988.	225 g meat (100 g clean meat). SCUBA prohibited. No factory ships. Closed season - July-September.
Cuba	1500 (1990) bait 55 (1994) food	n/a	Fully exploited. Peak harvest 2000 mt in 1977	Closed season. No juveniles. Quotas; annual quota of 55 mt for non-bait fishery. Prohibited recreational fishing. Regulations only apply to non-bait fishery. Catch not well utilised, mainly for bait.
Dominica	5 (1991)	n/a	Severely overfished	In draft; 225 g meat; 180 mm shell. Prohibited to harvest conch without flared (mature) lip.
Grenada	26 (1993)	n/a	Growth overfished	225 g meat; 180 mm shell. Prohibited to harvest conch without flared (mature) lip. Option for closed seasons.
Jamaica	2300 (1993-94) (800 from Pedro Bank)	89.1-277.0[4]	Current harvest rate probably not sustainable. SCUBA and HOOKA used	Interim commercial quota 2000 mt for 1994-95 season; quota to be reduced by 100 mt over next five years. Management strategy including limited entry closed season, protected areas and gear restrictions. No new licenses.
Martinique	20-30 (1990)	n/a	Inshore overfished. Deep water stocks available	Shell with flared lip, no juveniles; 250 g meat - only applies no marine reserve. SCUBA prohibited
Mexico	25 (1989)	n/a	Overfished. Peak production of 454 mt in 1979	Closed seasons. Annual quotas by areas.
Montserrat	0.5 (1994)	n/a		In draft, 225 g meat; 180 mm shell.

Table 1. Summary of queen conch fishery (continued)

Country	Landings mt (year)	Density (Conch/ha)	Stock Status	Regulations*/Comments
St. Kitts/Nevis	16 (1994)	n/a	Overfished in nearshore areas. SCUBA gear used to exploit deeper waters.	225 g meat; 180 mm shell. Prohibited to harvest conch without flared (mature) lip. Option for closed seasons.
St. Lucia	13 (1994)	n/a	Shallow water stocks over-exploited. Stable. Deep water stocks available.	225 g meat; 180 mm shell. Prohibited to harvest conch without flared lip. Must be landed whole. Option for closed seasons.
St. Vincent and the Grenadines	37 (1994)	n/a	Stable. Possibly overfished in nearshore areas.	225 g meat; 180 mm shell. Prohibited to harvest conch without flared (mature) lip. Option for closed seasons.
Turks and Caicos	510 (1994)	n/a	Stable. Probably fully exploited. Harvest peak of 904 mt in 1995.	227 g meat; 178 mm shell. SCUBA prohibited.
USA, Florida	Fishery closed in 1985	1.5-2.4[5]	Collapsed	Fishery closed in 1985. Good enforcement and compliance with closure. No significant recovery over last 10 years.
USA,Puerto Rico	73 (1989)	8.11[6]	Recruitment overfished. 1983 production was 340 mt	Regulations being considered.
USA, Virgin Islands	15 (1990-91) from St. Croix	7.6-12.25[7,8]	Generally overfished. Stable in St. Croix.	230 mm shell. Closed season - 1 July-30 September. Recreational limit of 6/person/day. Ban on fishing in St. Thomas and St. John.
Venezuela	400 (1988)	300-600[9] protected area	Overfished. Growth over-fishing. Estimated that 90% of harvested illegally from protected areas of Los Roques National Park.	Closed season (March to September) and areas. Three-year closure placed in 1991 but limited enforcement. No fishing allowed in Los Roques National Park.

Adapted from Tewfik (1995)

*Numbers refer to minimum weight and length.

(1) Smith and Neirop (1984)
(2) Stoner and Ray (1996)
(3) Berg et al. (1992)
(4) Appeldoorn (1995), Smickle (1995)
(5) Berg and Glazer (1995)
(6) Torres Rosado (1987)
(7) Wood and Olsen (1983)
(8) Friedlander et al. (1994)
(9) Weil and Laughlin (1984)

SECTION III:

- Status of Fisheries and Regulations by Country
- Other Comments

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN ANTIGUA AND BARBUDA

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INTRODUCTION

Antigua and Barbuda is a two-island state. Antigua is the largest and most populated of the islands (approximately 65,000 persons), while Barbuda, located 44.5 km (24 nm) towards the north, has a population of about 12,000 persons, most of whom fish for a living. The queen conch (*Strombus gigas* L.) is the most valuable species, after the spiny lobster [*Panulirus argus* (Latreille)]. The queen conch fishery for Antigua and Barbuda is considered overexploited, more for the island of Antigua than for Barbuda. Antigua is the main market for queen conch, but most of the conch fishers operate out of the island, while fishers from Barbuda tend to concentrate on lobster for export.

FISHING ACTIVITIES

The queen conch is mainly harvested for its meat, although there is a small trade for its shell, mostly for the local tourist market. Most of the conch is consumed locally, but there is a small trade, legal and illegal, to the island of Guadeloupe.

Antigua fishers, equipped with SCUBA tanks, dive to depths of 20 m to over 30 m (65 to over 100 ft) in areas around the island. The situation is different for Barbuda. Fishers there can still harvest conch by free diving at 6 m (20 ft) depth. However it is changing. Fishers are now getting SCUBA equipment, mainly for lobster, but they are slowly going into conch. Many accidents have occurred and the cost of the treatments is paid by the divers or their families. There is no governmental support. In the case of a serious accident, the diver has to be flown to the neighboring island of Guadeloupe and it could cost between US$ 3,000 and US$ 11,000.

The rivalry between the fishers of both islands and the distance between the islands discourage fishers from Antigua in going over to Barbuda and harvesting their conch. The industry is in small scale. There are only 5 full time fishing conch boats, others operate part time (with less than 20 divers).

CURRENT AND FUTURE RESEARCH

The government of Antigua and Barbuda is attempting to standardize its data collection process (fishery and biological related data). In 1996, a stock assessment program for lobster and conch was initiated by the local government, with the collaboration of the CARICOM

Fisheries Resource Assessment and Management Program (CFRAMP). This program runs simultaneously in other islands, all members of the Organization of Eastern Caribbean States (OECS), but according to the importance of the conch to their national economy.

REGULATIONS

There is a minimum size of 18 cm of total length (7 in), and the conch should have a flared lip, although there is no stipulation on its thickness. However, regulations are not strictly enforced. There are provisions for a closed season or for establishing closed areas. The regulations also provide for the setting up of marine reserves aimed at protection of the mangroves, sea grass and coral reefs. These marine reserves are in the preliminary stages of development.

FINAL CONSIDERATIONS

There are plans for a massive educational campaign before the introduction of a new regulation. In spite of the fact that there is an open access fishery, there have been no new entrances. In fact, there has been a decline as divers become injured and drop out of the fishery. The fisheries division has been actively encouraging divers into other methods of fishing, through training and assisting them in obtaining new gears.

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN THE BAHAMAS

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INTRODUCTION

The Bahamas covers a vast area greater than 343,450 km^2 (100,000 m^2) of water. Of this, 154,553 km^2 (45,000 m^2) comprise shallow waters (up to 200 m depth). The estimated length of the shallow water shelf has been estimated at 4,633 km (2,500 nm). The Department of Fisheries considers that conch stocks in The Bahamas are still in a healthy condition. This is partly due to the fact that the conch fishery represents a supplementary income for fishermen during the seasonal closure for lobsters. It is during this period that conchs are landed in large quantities. Conch landings usually account for approximately 10% of the weight of all fishery products landed in the country.

THE MARKET

Figure 1 shows the landings of queen conch (*Strombus gigas* L.) in The Bahamas. It also represents the trend of local consumption, since the landings of conch have always been based on the amounts the local market could absorb, and not driven by commercial exports. If conch harvests were large early in the year and inventories in the processing plants increased above a particular level, processors would then cease purchasing conch. As a consequence, fishermen would stop fishing for conch and landings would decrease. For example, during early 1989, there was a glut in the conch market and processors were holding almost 500,000 lb (227,000 kg) in their freezers. This forced processors to cease buying and therefore, fishermen reduced their production, leading to a sharp decrease in conch landings (Fig. 1).

At this point, processors clamored for the ability to export their conch products, in order to avoid severe socio-economic impacts on the fishermen's families. However, the Department of Fisheries held the view that the 250,000 Bahamian residents plus the 3 million tourists a year should be able to consume the conch that was landed. Notwithstanding, high product prices, a poor market structure, the consumer preference for fresh product and the lack of adequate promotion were handicaps to the governmental efforts to increase local conch consumption. Steps were then taken to develop market strategies to increase local consumption of conch. These strategies were effective and there were no excesses in 1990 and 1991.

Then, in June of 1991, there was an outbreak of food poisoning in New Providence. These casses were found to be due to the bacteria *Vibrio parahaemolyticus*. The source of the outbreak was identified to be conch that were stored in Nassau harbour and then sold by

vendors to consumers. Although the outbreak was a very localized event, conch sales decreased countrywide. Again, the processors ended up having more conch than they could manage and expressed their desire to be able to export the excess product.

In November of 1992, the ban on conch exports was lifted and a single export of 4,000 lb (1,816 kg) was made. During 1993 and 1994, conch landings increased as a result of commercial exports being permitted. However, during 1995, a quota system was established in order to limit exports. The effect of the quota was to cause a decline in total conch landings, a result of reduced purchases of conch from fishermen by processors. The quota established for 1995 was 250,000 lb (113,500 kg); 200,000 lb (90,800 kg) for 1996, and 100,000 lb (45,400 kg) for 1997. During 1993, a total of about 480,000 lb (217,920 kg) were exported, representing an income of US$ 930,000. This grew to over 785,000 lb (356,390 kg) in 1994, with a value of about US$ 1.84 million. The total exports for 1995 were actually 275,000 lb (124,850 kg), about 25,000 lb (11,350 kg) above quota. The additional amount was due to allowances granted to some processors. By July 1996, approximately 127,000 lb (57,658 kg) have been exported.

CURRENT AND FUTURE RESEARCH

The implementation of quotas was established as a precautionary measure. This was due to the lack of scientific evidence that the stocks could withstand the additional pressure caused by exports. The Department of Fisheries proposes to conduct a three year assessment project (to begin late 1996), that will also develop management options for the fishery: results of project will determine the future of management decisions for the stocks.

REGULATIONS

The regulations in effect on the harvest of queen conch in The Bahamas are:

1) No capture, possession nor sale of conch without a well-formed lip.

2) No commercial export of conch or conch by-product without a license issued by the minister responsible and inspection by the Department of Fisheries.

3) Non-commercial exports are limited to 10 lb (4.5 kg) for any person, and should be in your personal baggage as you leave the country.

4) Sport fishing regulations allow the harvest of 10 conch per person, on their own vessel while in possession of a sport fishing permit.

5) Compressors can be used for commercial fishing, but only during the lobster season (August 1 to March 31). In order to use a compressor the fisherman must have a permit from the Department of Fisheries, which is issued only to certified and trained divers. Since 60 - 70% of the conch is caught during the seasonal closure for lobsters, there is a technical limitation to the use of compressors.

6) In 1959 the Exuma Land and Sea Park was created. It was the first marine reserve in this hemisphere. All fisheries are closed in the entire area of the park and serious enforcement is in place.

FINAL CONSIDERATIONS

In The Bahamas, there is a developing industry based on the conch shells. The shells are cleaned and polished and sold to tourists to take home. Also, with the assistance of the Taiwanese Government, we are developing a jewelry manufacturing industry using the conch shells to make brooches, earrings, and cameos. These actions help reduce the numbers of discarded shells. These should perhaps be considered by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) as acceptable methods of dealing with the by-products of local consumption and export of conch.

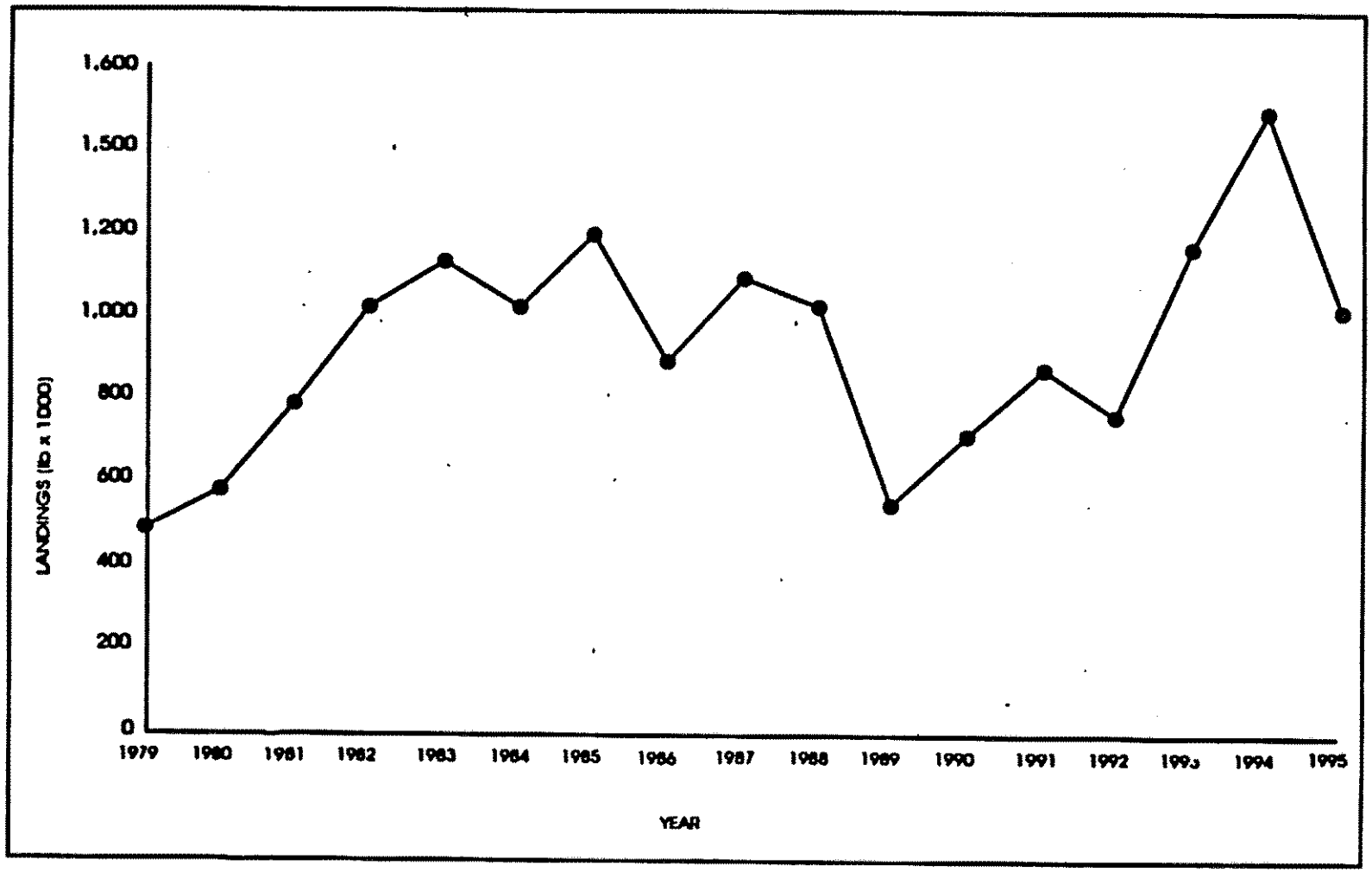

Figure 1. Total recorded landings of queen conch in The Bahamas.

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN BELIZE

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INTRODUCTION

The fishing industry is a major contributor to the Belizan economy, primarily in respect to foreign exchange earnings. In the early '70s, conch export exceeded 1.2 million lb (544,800 kg), making Belize one of the largest conch exporters in the world. However, in the late '70s, there was a major decrease in the catch and current levels average about 400,000 lb (181,600 kg) per year.

FISHING ACTIVITIES

At present, we have an open-access situation for all Belizans, as well as legal aliens and sport fishers, although all vessels and fishers must be licensed. However, the amount of illegal catch sold outside of Belize or used for internal consumption is unknown in Belizan waters.

CURRENT AND FUTURE RESEARCH

The Department of Fisheries and the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP) have implemented a conch survey, in the shallow coastal waters of Belize and the three atolls, in order to assess the fisheries resource and to delineate nursery grounds for protection. The general objectives of this survey are: 1) to conduct an abundant survey of conch within Belizan waters in order to predict the sustainability of the resource and to suggest management practices to protect the fishery; 2) to delineate conch nursery grounds in order to protect those areas from over-fishing; and 3) to construct a baseline biological database against which the findings of future surveys may be compared in order to assess the effects of natural variation and fishing pressure. The fieldwork started in January of 1996.

REGULATIONS

Several regulations are in effect in Belize to protect the conch populations:

1) Conch will be fished only by free diving. Fishers are thus limited to the shallower inner reef areas, where sea grass beds predominate and juvenile conch aggregate. The use of SCUBA equipment or compressors is strictly prohibited.

2) The conch fishery is closed from July 1 to September 30, which is the main breeding season and conch typically move into shallow water to mate and lay eggs.

3) There is a minimum legal size of 18 cm in shell length. Also, a 86 g of cleaned meat weight is imposed. The shell length is a guide for the fishers when sorting their catch at sea and the meat weight is for enforcement purposes when the cleaned meat is landed.

ESTADO ACTUAL DEL CARACOL PALA (*Strombus gigas*) EN EL DEPARTAMENTO ARCHIPIELAGO DE SAN ANDRES, PROVIDENCIA Y SANTA CATALINA (COLOMBIA)

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INTRODUCCION

El Departamento Archipiélago de San Andrés, Providencia y Santa Catalina está ubicado al suroccidente del Caribe (entre 12° y 16° N; 78° y 82° O), frente a la plataforma continental de Nicaragua y separado de ésta por el canal de San Andrés. El Departamento abarca una extensión aproximada de 43,200 m^2. Existen tres islas mayores, San Andrés, Providencia y Santa Catalina. Sin embargo, al norte y al sur existen numerosos islotes, cayos, bancos y bajos de menor tamaño, entre los que podemos mencionar a Serrana, Roncador y Quitasueño, al norte, y Albuquerque y Bolívar, al Sur (Figura 1).

La pesca artesanal se ejerce en la isla de Providencia y los cayos de Albuquerque y Bolívar, mientras que la pesca industrial se realiza en los bancos de Serrana, Roncador y Quitasueño. Esta separación se debe a que sólo los pescadores industriales disponen de la capacidad para recorrer las considerables distancias que separan la isla de San Andrés o la ciudad de Cartagena (litoral caribe colombiano) de los bancos mencionados anteriormente. Por su parte, los pescadores artesanales no permiten el ingreso de pescadores industriales a sus zonas de pesca. En la actualidad, la pesca del caracol pala (*Strombus gigas* L.) en el Departamento Archipiélago de San Andrés, Providencia y Santa Catalina, representa una producción de 169 tm para la pesca industrial y 5.45 tm para la pesca artesanal, para un total de 174.45 tm.

ACTIVIDAD PESQUERA

Por su parte, el Instituto Nacional de Pesca y Acuicultura (INPA) ha venido realizando unas estimaciones de la captura por unidad de esfuerzo (CPUE) en el área del Archipiélago (Tabla 1). Si bien la CPUE no es un valor que permita medir en términos absolutos la eficiencia de una pesquería, al menos permite establecer una comparación a través del tiempo. Desde este punto de vista, se pone de manifiesto una disminución consistente y substancial de la CPUE entre 1991 y 1994.

El registro de los desembarques de caracol pala provenientes de la flota pesquera industrial, ha sufrido de fluctuaciones debido a la desorganización en la recolecta de datos, por parte de las instituciones del estado, y debido a la falta de colaboración por parte de las empresas pesqueras. La Tabla 1 muestra los desembarques de caracol pala en el Departamento Archipiélago de San Andrés, Providencia y Santa Catalina. Entre 1972 y 1984 sólo se registran niveles muy bajos de capturas, por lo que desconfiamos de estos datos.

A partir de 1984, las capturas se elevan al orden de las 227 tm. Desde 1991, la información se toma directamente de las empresas pesqueras, las cuales están dedicadas básicamente al comercio de exportación. Cada embarcación (9 con base en Cartagena y 4 en San Andrés) debe llenar un formulario al llegar a puerto, en el que declara las capturas. Este es un requisito previo para que se le autorice un nuevo zarpe. Igualmente, la empresa debe hacer una declaración de exportación ante el Instituto de Comercio Exterior (INCOMEX), con lo cual se establece un cruce de información. Es de hacer notar que INCOMEX registra unos niveles de exportación mucho más bajos que los esperados en base a lo reportado por las empresas. Se considera que esto es debido a que las empresas siempre inflan sus datos con el objetivo de obtener cuotas mucho más altas el próximo año.

INVESTIGACION

En el área del Archipiélago se han realizado dos evaluaciones del caracol pala. García (1991) determina que la época de reproducción y desove (julio y septiembre), así como estima diversos parámetros poblacionales (L_∞ = 32.6 cm; K = 0.72 año^{-1}) y pesqueros, como densidad promedio en el Archipiélago (D = 0.09 ind/m^2), mortalidad total (Z = 5.263 año^{-1}), natural (M = 1.397 año^{-1}), por pesca (F = 3.866 año^{-1}) y cosecha por recluta (E_{max} = 0.633; $E_{0.1}$ = 0.622; $E_{0.5}$ = 0.366). Márquez (1993), específicamente para la isla de Providencia, determina una actividad reproductiva entre abril y septiembre, así como una talla media de madurez sexual de 24 cm para las hembras y de 22 cm para los machos. Igualmente suministra información sobre la densidad a diferentes profundidades (12-15 m = 1.02 ind/m^2; 15-18 m = 0.82 ind/m^2; >18 m = 0.146 ind/ m^2) y estima los parámetros poblacionales (L_∞ = 37.5 cm; K = 0.25 año^{-1}) y pesqueros (Z = 2.48 año^{-1}, M = 0.67 año^{-1}, F = 1.81 año^{-1}, Emax = 0.735).

REGULACIONES

En Colombia, existen tres regulaciones las cuales engloban las consideraciones fundamentales de manejo; estas son:

ACUERDO No. 0017 (1990). Aplica para el área del Archipiélago de San Andrés, en especial en el área del Tratado Vásquez-Saccio de 1972. Este acuerdo establece:

1) Continuar con la veda permanente para la pesca de caracol pala en el bajo Quitasueño.

2) Prohibir la captura o posesión (en embarcaciones, plantas procesadoras o expendios) de ejemplares juveniles cuyo peso de carne sea inferior a los 225 g (sin limpiar), o a los 100 g (limpios).

3) Prohibir el uso de equipo de buceo autónomo (tanques) o semi-autónomo (compresores), así como el uso de redes agalleras y trasmallos (de nylon monofilamento) para la extracción de productos hidrobiológicos.

4) Prohibir la operación de todo buque factoría, es decir, aquel que procesa, transforma y empaca a bordo los recursos hidrobiológicos.

RESOLUCION No. 00179 (1995). Decide:

1) Continuar con la veda permanente para la pesca de caracol pala en el bajo Quitasueño.

2) La veda de pesca de caracol en el resto del Archipiélago de San Andrés se establece entre el 1 de junio y el 31 de octubre de cada año.

3) Se prohibe su importación durante el período de veda.

4) Las importaciones, en la época autorizada, deberán cumplir con todas las disposiciones legales vigentes, establecidas por el INCOMEX, la Dirección General de Aduanas y el Ministerio del Medio Ambiente (este último, en lo relacionado con la obtención del permiso de Comercio Internacional de Especies Amenazadas de Flora y Fauna Silvestre, CITES).

ACUERDO No. 0011 (1995). Establece fijar una cuota máxima de 203 tm para la extracción del caracol pala durante 1996.

CONSIDERACIONES FINALES

Tomando en cuenta el Código de Conducta para la Pesca Responsable y siguiendo las directrices para la Aproximación Precautoria a la Pesquería (FAO 1995), se han propuesto (algunas están en marcha) las siguientes medidas para el manejo y ordenamiento del caracol pala en el Departamento Archipiélago de San Andrés, Providencia y Santa Catalina:

1) Ampliación de la veda del Caracol que se estableció en la resolución No. 00179 de 1995;

2) Mejorar el control que los funcionarios del estado deben ejercer a nivel de los desembarcos en las plantas;

3) Mejorar la capacidad de análisis de la pesquería iniciando la recolecta de información económica;

4) Mejorar la calidad de las estadísticas pesqueras (desembarques, esfuerzo, etc) mediante la recolección directa de información en el litoral continental y en la isla de San Andrés;

5) Controlar el esfuerzo de pesca estableciendo límites al número de embarcaciones dedicadas a la extracción de este recurso;

6) Coordinar los proyectos de investigación y monitoreo junto a la actividad de extracción comercial del caracol pala por parte de la empresa privada. Esta estrategia tiene el doble propósito de: a) establecer recomendaciones (cuotas de captura, número de buzos, extensión de las campañas) orientadas hacia el uso sustentable del recurso; y b) disminuir la presión pesquera en el Departamento Archipiélago de San Andrés, orientando los esfuerzos de las empresas hacia las zonas costaneras. Para ello se tiene contemplado el realizar unas campañas de pesca exploratoria en el litoral de La Guajira, limitando la extracción a los ejemplares adultos en la franja de los 20 m;

7) Imponer severas medidas a las empresas que no cumplan con la reglamentación referente al peso mínimo de desembarque.

A nivel regional se establecen las siguientes recomendaciones:

1) Establecer una veda en toda el área del Caribe entre el lro de mayo y el 30 de septiembre de cada año (época reproductiva);

2) Establecer un programa de manejo especial en aquellas áreas consideradas de crianza y reserva genética;

3) Establecer un programa en cada país (de acuerdo a su conocimiento) que fomente la rotación de áreas de pesca, permitiendo así la recuperación de aquellas áreas que hayan sido sobreexplotadas;

4) Estandarizar la metodología para recolectar información de campo y en los centros de acopio (volumen y tallas de captura, esfuerzo, desembarques). Esto permitiría la comparación de los resultados entre los diferentes países del área;

5) Diseñar y divulgar, entre los pescadores (artesanales e industriales), los empresarios y el público en general, una serie de campañas educativas orientadas a la protección y uso sustentable del recurso;

6) Robustecer y apoyar los estudios dedicados al cultivo del caracol pala en condiciones de laboratorio, así como proteger los sitios naturales de crianza. Todo esto con el objetivo de fomentar la repoblación;

7) Fijar (de acuerdo a las consideraciones de cada país) tallas mínimas de captura (longitud y peso). Para Colombia, el INPA recomienda: longitud total (desde el ápice hasta el canal sifonal) = 240mm; grosor del labio (en su parte más ancha) = 5 mm; peso (sin limpiar) = 170 g; peso (limpio) = 130 g; y

8) Se recomienda adoptar la convención CITES.

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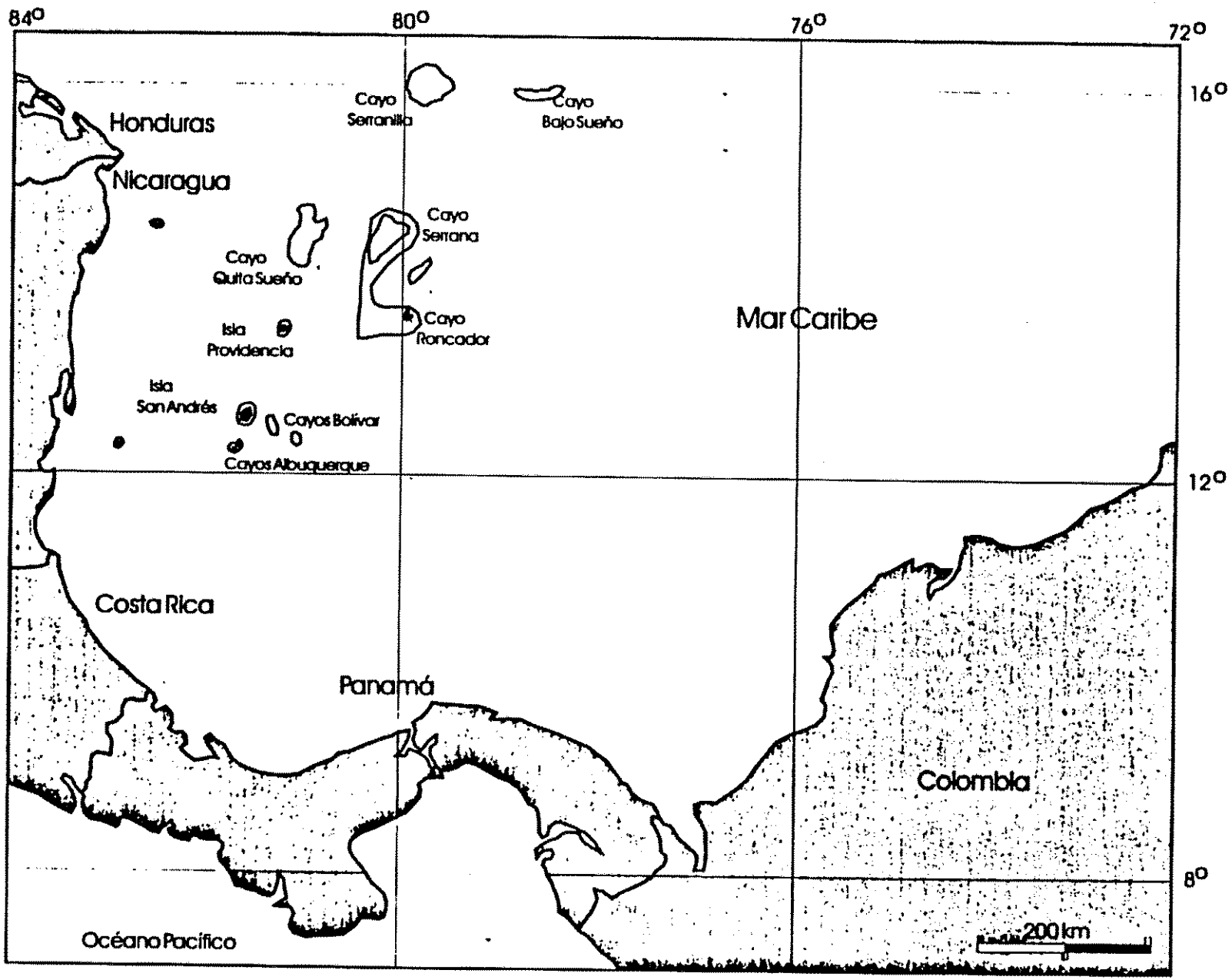

Figura 1. Ubicación del Departamento Archipiélago de San Andrés, Providencia y Santa Catalina, Colombia.

Tabla 1. Desembarques del caracol pala en el Departamento Archipiélago de San Andrés, Providencia y Santa Catalina, Colombia.

Año	Captura (tm)
1972	3.98
1973	10.77
1974	12.25
1975	5.03
1976	1.35
1977	1.12
1978	6.23
1979	n/d
1980	n/d
1981	n/d
1982	n/d
1983	n/d
1984	39.43
1985	227.64
1986	108.08
1987	122.00
1988	60.56
1989	17.56
1990*	317.40
1991*	447.90
1992*	465.70
1993*	220.70
1994*	240.30

n/d = no disponible

* Información suministrada directamente por las empresas pesqueras

Tabla 2. Capturas, dias de pesca y número de buzos (por embarcación:mínimo y máximo) y captura por unidad de esfuerzo (mínimo, maximo y promedio) del caracol pala entre 1991 y 1992, en el Departamento Archipiélago de San Andrés, Providencia y Santa Catalina.

Año	No. Compañías operando	Capturas (kg/embarcación)		Dias de Pesca (por embarcación)		No. buzos (por embarcación)		CPUE (kg/buzo/dia)		CPUE (kg/buzo/dia)
		mínimo	máximo	mínimo	maximo	mínimo	maximo	mínimo	máximo	promedio
1991	7	2,500	5,500	9	o3	7	20	1.98	47.62	27.07
1992	14	14	9,000	3	40	2	o0	o.25	35.00	14.97
1993	49	5	17,5o0	1	40	1	60	1.39	42.50	3.34
1994	27	35	15,177	1	28	3	o0	0.15	52.o3	2.55

LA PESCA DEL CAMBUTE, *Strombus gigas* EN COSTA RICA

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INTRODUCCION

La costa caribeña de Costa Rica abarca una extensión de 204 km. Limita por el norte con Nicaragua y al sur con Panamá. Sin embargo, es sólo en Puerto Limón donde se pueden observar formaciones arrecifales (Figura 1). La costa caribeña de Costa Rica alberga cerca de 11 comunidades pesqueras, con aproximadamente 350 pescadores permanentes, totalmente artesanales. Los principales recursos pesqueros son la langosta espinosa [*Panulirus argus* (Latreille)] y la tortuga verde (*Chelonia mydas* L.).

La costa caribeña costarricense comienza a tener presencia a nivel nacional a partir de 1994, con la creación del Instituto Costarricense de Pesca y Aquacultura (INCOPESCA), y a nivel internacional en noviembre de 1995, cuando nos afiliamos a la Comisión de Pesca para el Atlántico Centro-Occidental (COPACO).

ACTIVIDAD PESQUERA

El cambute (*Strombus gigas* L.) se encuentra en pequeñas poblaciones en la región de Puerto Limón (Figura 1), específicamente en las zonas de Manzanillo, Puerto Vargas, Isla Uvita, Punta Cahuita, Piuta, Punta Mona y Punta Uva (en orden decreciente de abundancia). Este recurso no ha sido evaluado desde el punto de vista biológico, ni pesquero.

En base a lo indicado por 20 pescadores (buzos) del área, se puede inferir que el cambute es cosechado mediante el buceo o utilizando redes de enmalle (trasmallo). Los buzos pueden operar a pulmón (a profundidades entre 2 y 7 m) o utilizando equipo autónomo (tanques; a profundidades entre 15 y 20 m). Los trasmallos se colocan entre 15 y 25 m de profundidad. Actualmente, un buzo es capaz de recolectar entre 2 y 5 especímenes por inmersión, mientras que el trasmallo rinde entre 10 y 15 especímenes por lance. La producción se destina al consumo local, básicamente casero. La época de mayor abundancia se estableció entre marzo y junio, y de septiembre a octubre. En julio no se captura.

REGULACIONES

En Costa Rica se dispone del Decreto Ejecutivo No. 19647 (Ministerio de Agricultura y Cría, mayo de 1990) que prohibe de forma permanente la captura y comercialización de las especies de cambute, *Strombus gigas* (en el Caribe) y *Strombus galeatus* Swainson (en el Pacífico).

CONSIDERACIONES FINALES

Los entrevistados manifestaron que la abundancia del recurso ha mermado en los últimos 10 años. Entre los factores que contribuyen a este descenso tenemos: a) la elevada tasa de sedimentación sobre áreas arrecifales; b) el uso de agroquímicos en los cultivos del banano; c) la descarga de hidrocarburos; y d) un posible efecto del terremoto del año 1991 en la región costera. Finalmente, es bueno hacer notar que esta porción arrecifal está siendo protegida por la creación de Parque Nacional Cahuita-Puerto Vargas (Decreto Ejecutivo No. 1236-A, septiembre de 1970) y el Refugio Nacional de Vida Silvestre Gandoca-Manzanillo (Decreto Ejecutivo No. 16614, Ministerio de Agricultura y Cría, julio de 1985) .

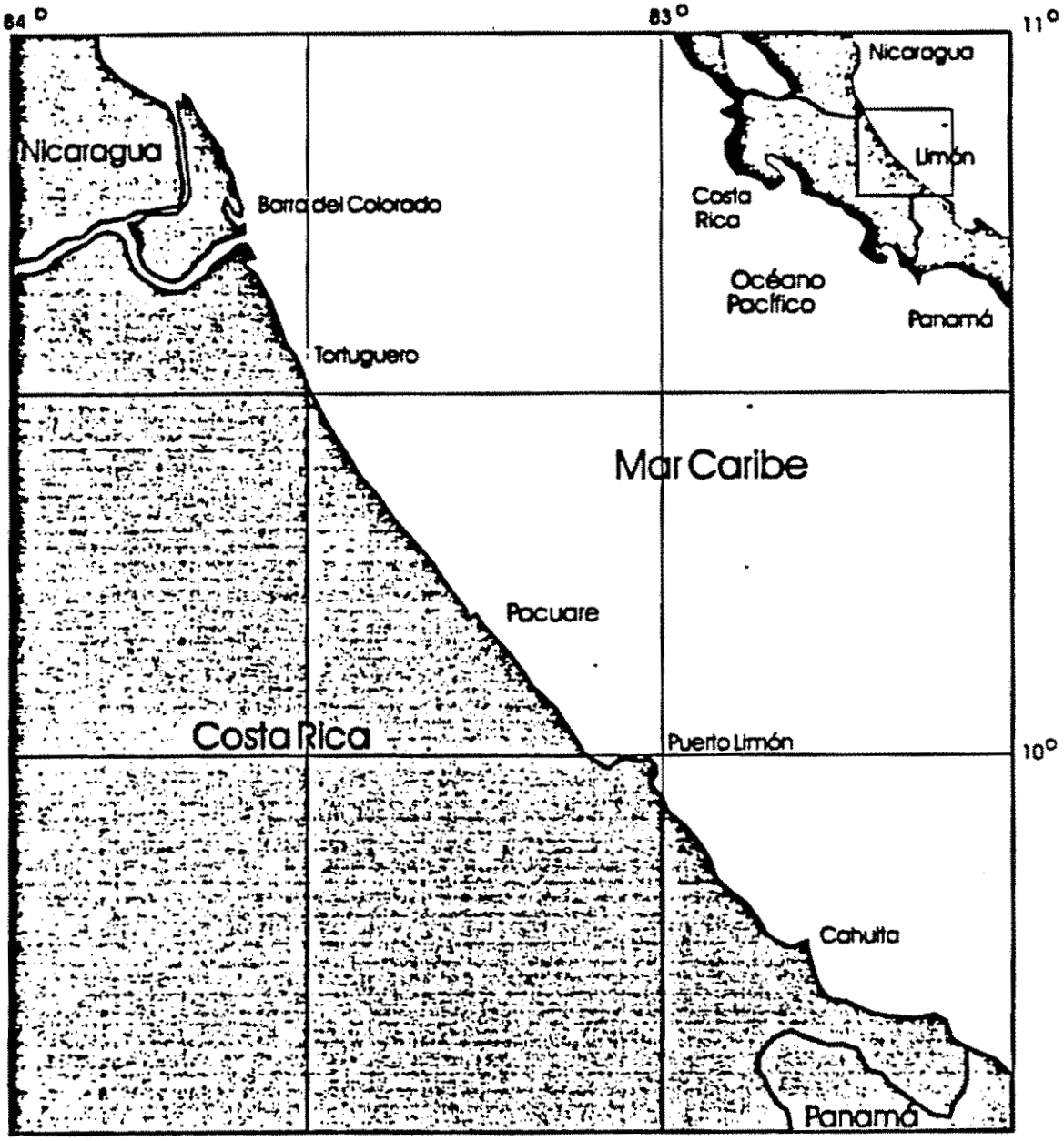

Figura 1. Mapa de la costa caribeña de Costa Rica

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN HAITI

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INTRODUCTION

The Republic of Haiti shares with the Dominican Republic the island of Hispaniola. Hispaniola is surrounded on the north by the Republic of Cuba and the United States (south Florida), on the south by the Caribbean Sea, on the east side by Puerto Rico and on the west side by Jamaica. The Republic of Haiti covers an area of 27,750 km^2 and has a population of 7 million people. Its coastline is 1,535 km long, and the platform covers 3,500 km^2. The total production of fish, crustaceans and molluscs is 6,500 mt.

CURRENT AND FUTURE RESEARCH

Previous to 1985, the Republic of Haiti did not have any information about the conch situation. By the end of 1994, the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) was asking in the international community about the situation of conch in Haiti and the industry had to stop the exportation of shell conch. The Ministry of Agriculture of Haiti gathered the business persons and decided together to make a study about the status of the resource. With the technical support of the Marine Conservation Society, Haiti carried out its first Queen Conch stock evaluation in 1995. Seven areas where conchs were known to occur, or to haveoccurred in the last few years, have been considered:

1) The north side of Haiti, facing Cuba, includes good conch habitat. It is not thought to be heavily fished. The coastline is exposed to heavy seas and access to fishing grounds are considered difficult.

2) The area of Gonaives and its extended offshore shelf is reported to support a productive conch fishery. The fishers are very protective of their fishery resources, preventing outside fishers from operating and specially using compressed air systems (HOOKAH). Overfishing may not be a serious problem because fishing pressure is relatively low.

3) The area of La Gonave Island (around the capital, which is the main market) consists of a shallow shelf, with considerable sites in the range of 5 to 30 m depth. There is evidence of over-fishing, such as: a) the need to use compressors; b) the difficulties faced by fishers in harvesting conch; c) the harvest of juveniles and sub-adult specimens; and d) the accumulation, in many places along the shore, of thousands of under sized shells (from juveniles to 20 cm in length, just reaching maturity). Only 16 conch were found in a 1.5 ha

search. All, including those with larger shells (22-23 cm in length), were thin-lipped, immature individuals. The density of adults suitable for harvesting was zero. This is the same situation as in the area of Les Cayimites.

4) The area of Rochelois Bank has a shallow flattish top, on which a single small islet is found. One to two compressors are used on the bank for HOOKAH diving, but much of the conch fishing is done by free-diving. The density is around 15 mature adult/ha. Only 23 individuals were found in a 0.4 ha search (6 with either thickening or thick lips and 17 juveniles to subadults).

5) The area off the western end of the southern peninsular of Haiti, facing Jamaica is a very productive conch fishing ground. Large conch are plentiful and fishers do not bother to collect juveniles. The huge piles of conch on the beach consists almost entirely of thick-lipped adults. The density is abount 160 conch/ha (18.3-22.8 cm length).

THE MARKET

Consumption of conch meat and export of conch shells are activities of economic importance in Haiti. They can be only estimated because of the lack of accurate records.

The conch meat is very popular throughout Haiti and is a staple food for many fishers and their families. Local consumption of fresh meat can be estimated at over 70 mt/year. There is no export of frozen conch meat at present. The price of conch meat as sold by the fisher is around US$ 0.80-1.00/lb (US$ 1.76-2.20/kg) and the sale price in the cities is approximately US$ 1.75/lb (US$ 3.85/kg).

Until 1985, the shells were sold directly to visitors, but since the decline of tourism, local sale of conch shells has been negligible. However, Haiti has exported conch shells for many years. In 1995, the export of shells was around 175 mt, with 75% of the weight attributed to *Strombus gigas* shells. The shell is sold by the fisher at about US$ 0.70/each to local exporters and US$ 1.00/each to tourist. Fishers do not normally pull out the meat without breaking the shell, unless they have an assured sale for the shell. This is the reason why there are, in many fishing villages, tons of broken shells.

REGULATIONS

The Ministry of Agriculture of Haiti is planning to implement, in the near future, the following regulations:

1) Prohibit the capture of immature conch by setting limit on shell lip-thickness (as established by Law in November, 1978).

2) Prohibit the use of compressors and SCUBA gear.

3) Establish a community-based educational program.

4) Establish a monitoring program.

5) Access to new markets for conch shells and reduce the number of broken shells.

LA PESCA DE CARACOL GIGANTE, *Strombus gigas* EN HONDURAS

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INTRODUCCION

La pesca del caracol gigante (*Strombus gigas* L.) se inició en Honduras a finales de la década del 70, como resultado de la necesidad de explotar un nuevo recurso pesquero. Hasta entonces, la actividad pesquera se había concentrado únicamente en la captura de camarón y langosta. La producción de caracol gigante se ha ido incrementando cada año, hasta alcanzar las 832.3 tm en 1995.

ACTIVIDAD PESQUERA

El caracol gigante se pesca en los bancos hondureños de Rosalinda, "Thunder Knoll", Gorda y Media Luna, así como en el arrecife Lagarto, todos ubicados al norte del paralelo 15. También se le captura en los bancos ubicados al norte de las Islas del Cisne, Misteriosa y El Rosario, en la ruta hacia la isla de Gran Caimán.

La pesca se realiza a nivel industrial y artesanal. Sin embargo, sobre esta última no se dispone de suficiente información. La pesca industrial es desarrollada por barcos madres (11 para 1995) los cuales tienen su base de operaciones en Islas de la Babia, particularmente en los puertos pesqueros de "French Harbor", "Oak Ridge", "Jonesville" y Guanaja. Cada barco madre puede acarrear de 20 a 30 cayucos, cada uno operado por un buzo y un remador, por lo que cada barco madre puede transportar entre 40 y 60 pescadores. Los buzos son en su mayoría indígenas Misquitos, quienes utilizan equipo de buceo autónomo (tanques) y se sumergen a profundidades entre 45 y 70 pies (14 y 21 metros) por periodos de 25 a 40 minutos.

El éxito de la captura depende de la zona de pesca y la época del año. Un cayuco puede cosechar de 60 y 80 lb (27 a 36 kg) de carne de caracol diarios, durante los meses de mayor abundancia (agosto y septiembre). La captura es depositada en bolsas plásticas, formando paquetes de 50 a 60 lb (22 a 27 kg) cada uno y se almacenan en la bodega del barco. Después de dos semanas de pesca, el barco madre se dirige hacia los Cayos Vivorillos donde transfiere su captura a un barco nodriza. Los barcos nodriza se encargan de transportar el producto a las Islas de la Babia, donde operan las plantas procesadoras. Allí el producto se somete a un proceso de limpieza y empaque, en cajas rotuladas de 5 a 10 lb (2.3 a 4.5 kg), y finalmente se exportan hacia el mercado estadounidense. La producción comenzó a ser reportada a partir de 1988 (93.6 tm) y alcanzó las 832.3 tm en 1995 (Figura 1).

INVESTIGACION

Con el propósito de elaborar el plan futuro de manejo de los recursos en explotación, el Centro Regional de Investigación Pesquera del Caribe Centroamericano (CRIPCCA), dependiente de la Secretaría de Recursos Naturales y con la cooperación financiera de la Comunidad Económica Europea a través del proyecto de apoyo al desarrollo de la pesca (PRADEPESCA), lleva a cabo el registro de las actividades a bordo de las embarcaciones pesqueras durante las estaciones seca y lluviosa. Además, recolectan información estadística en las plantas pesqueras. Por su parte, el Instituto Smithsoniano de Honduras observa constantemente el comportamiento de la población de caracol gigante que se encuentra en la reserva marina de Cayos Cochinos.

REGULACIONES

Los intentos de regular la explotación del caracol gigante en Honduras se iniciaron en 1991, cuando la Secretaría de Recursos Naturales decretó una veda pesquera durante los meses de julio y agosto (Resolución #006-91). Sin embargo, ésta no se implementó debido a las fuertes protestas del sector pesquero industrial. En 1993 se decretó una nueva resolución (Resolución #001-93), en la cuál se estableció, por recomendación de la flota pesquera industrial, una época de veda durante los meses de abril y mayo. Para 1995 el período de veda se amplió a 4 meses y medio (del 16 de marzo al 31 de julio; Resolución #001-95) y ese mismo año se presentó una nueva regulación (Resolución #030-95), orientada a controlar la actividad pesquera durante 1996. Las resoluciones allí contempladas incluyen lo siguiente:

1) Establecer una veda a la captura de caracol desde el 16 de marzo al 30 de agosto.

2) La talla mínima de captura del caracol gigante será de 22 cm medida desde el canal posterior al canal sifonal.

En 1996 y considerando que la convención sobre el Comercio Internacional de Especies Amenazadas de Flora y Fauna Silvestres (CITES, por sus siglas en Inglés) incluye al caracol gigante dentro del Apéndice II, la Secretaría de Recursos Naturales estableció la Resolución #002-96, mediante la cuál regula la comercialización de este recurso de acuerdo a las especificaciones establecidas en dicha convención.

CONSIDERACIONES FINALES

Se recomienda que las investigaciones desarrolladas por el CRIPCCA se extiendan al sector artesanal, ya que éste juega un papel importante en la explotación del recurso, en particular en lo destinado al consumo interno. Los resultados de estas investigaciones deberán ser utilizados para evaluar y mejorar el presente plan de manejo.

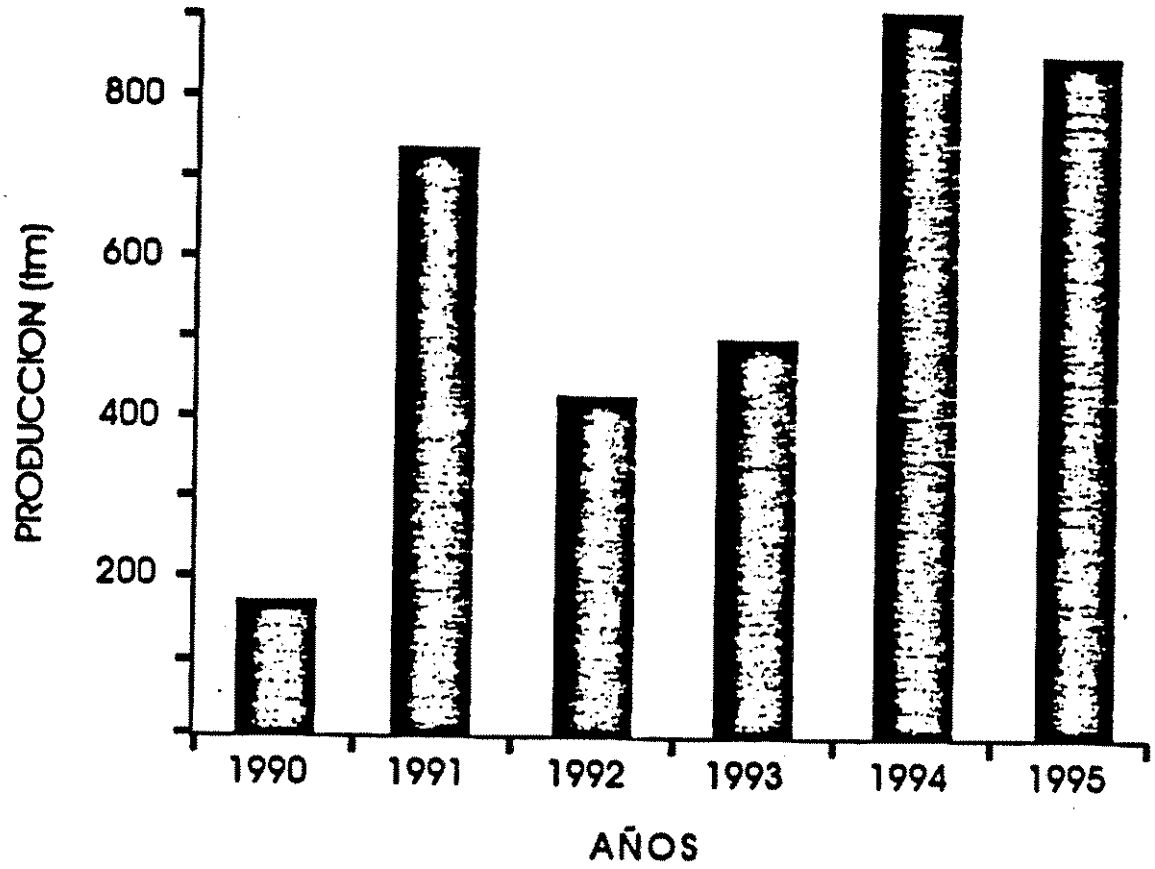

Figura 1. Producción industrial del caracol gigante, *Strombus gigas*, entre 1990 y 1995.

CONSIDERATIONS FOR THE QUEEN CONCH MANAGEMENT PLAN IN JAMAICA

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INTRODUCTION

As far back as 1989, Jamaica began to focus its attention on the rapidly expanding industrial fishery for the queen conch (*Strombus gigas* L.). There was growing concern by the Fisheries Division and conch producers that the high levels of production would lead to overexploitation and eventually the collapse of the valuable fishery.

PAST, CURRENT AND FUTURE RESEARCH

In 1991, the Jamaica Fisheries Division conducted a preliminary study of the queen conch stocks on the Pedro Bank, its major fishing ground. The study was assisted by the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP) and the University of the West Indies (UWI). This study, which focused on the population found at the range of depth where commercial fishers were diving, provided a rough first estimate of the biomass and the maximum sustainable yield (MSY) of queen conch available to the fishery on the bank.

The results suggested that the bank's conch stocks were being overexploited and if the levels of harvesting continued, the fishery would collapse within a given period. As a consequence of the study, the Fisheries Division in conjunction with CFRAMP, the Jamaica Conservation and Development Trust (JCDT), a Jamaican non-governmental office, and the University of the West Indies, convened with conch producers to organize two conch management workshops in August and October, 1992. These workshops and the numerous subsequent meetings played an integral part in the development and fine tuning of the Jamaica Conch Fishery Management Plan.

That year, the queen conch was listed in Appendix II of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). This development was very instrumental in the decision of Jamaica to employ catch quotas as part of the conch management strategy, despite the fact that there are many examples its failure as an effective management tool (e.g., Canadian cod fishery). The three most important factors that led to the decision of use catch quotas as management tool were:

1) The Jamaican conch fishery is largely export oriented and the local market was and remains very small.

2) The binding obligations of Parties to CITES with respect to the importation of queen conch that require *inter alia* certification from third countries (i.e., France, United States and Puerto Rico, the major export markets).

3) Once Jamaica becomes a Party to the Convention, all conch exported from Jamaica, to Parties or Non-Parties, must be certified. This will provide a cost effective and workable system of controlling and monitoring the quantity of conch exported and hence, landed and processed.

The Jamaican conch producers fully recognized that the results of the 1991 preliminary survey were at best rough estimates. Despite this, in early 1993, conch producers agreed to cut their potential production levels (per vessel per trip) by 50%. It was translated to Total Allowable Catch (TAC) of 3,000 mt for the 1993-1994 conch fishing season, but pending of the results of further studies at Pedro Bank.

One of this was conducted in 1993, by the Fisheries Division in conjunction with the Acadia University, Canada. Preliminary analysis suggested that production levels were unsustainable. Regardless that the scope of this study was too limited to generate reliable estimates of potential yield, but based on the principle of using the best available scientific data and the precautionary approach, a further 50% decrease in the TAC was implemented for the 1993-94 conch fishing season (1,500 mt), coupled with the voluntary reduction of conch fishing licenses to a maximum of two per company.

In November and December of 1994, a comprehensive conch abundance survey was conducted on the Pedro Bank. This study was totally funded by Jamaican conch producers and represents a very fine example of cooperation between government agencies, non-governmental organizations, stakeholders and committed scientists from within the Caribbean region. The field data were collected by commercial fishers under the supervision of fisheries scientists from governmental and non-governmental organizations and data were analyzed and interpreted by Dr. Richard Appeldoorn of the University of Puerto Rico. The study indicated that the Pedro Bank has densities of queen conch that are 10 to 100 times higher than that of other areas studied. Based on this, Jamaica adjusted the 1994-95 TAC to 2,000 mt, with the proviso that the TAC will be reduced by 100 mt every year during five years, when the conch producers must fund another abundance survey. However, conch producers are given the option of funding the survey during the third year.

REGULATIONS

The Jamaica Conch Management Plan was developed and established after extensive consultation with conch producers. This consultative approach has and continues to be the most significant factor in the success of the sustainably manage Jamaican conch resources. The major elements of Jamaica's Conch Fishery Management Plan are:

1) Catch quotas: A National Total Allowable Catch (NTAC) and an area specific total allowable catch referred to as a Fishery Management Area Total Allowable Catch (FiMATAC) have been established. The catch quota is currently based on available scientific data of the conch stocks on the Pedro Bank. However, conch is harvested from other areas within Jamaica's maritime space, such as the island shelf, both north and south, and other offshore banks such as the Morant Baltic. It is our intention to establish, after the requisite scientific work, catch quotas for all areas that have the potential to support a conch fishery.

2) Limited entry: New licenses will be issued only under specific conditions such as i) sound scientific evidence to justify increased effort; and ii) the cancellation or voluntary

retraction of licenses. In addition, the number of divers per vessel are limited depending on the type of gear utilized and the catch quota in force from time to time.

3) Closed Season: There is an annual four month closed season, starting on the 1st July and ending on the 31st October.

4) Minimum Size: A legal minimum size of 84 g for fresh product, with the digestive sac and operculum removed, has been established.

Not all the elements of the management plan have been implemented. The only legislation in place is that which establishes the annual closed season. All other significant elements of the plan have been established through voluntary compliance of conch industry members and adherence to strict policy guidelines by the Government of Jamaica.

FINAL CONSIDERATIONS

Although Jamaica has not yet ratified the CITES, we have implemented and fulfilled all the necessary institutional, operational and reporting requirements under the Convention. The Natural Resources Conservation Authority (NRCA) functions as the Jamaica CITES Management Authority and there is an independent scientific authority currently under the chairmanship of Prof. Ivan Goodbody.

With respect to the establishment of a regional mechanism for the management of the queen conch, the Government of Jamaica recognizes that there will be tremendous benefit from such an approach. However, the Government of Jamaica strongly believe that the emphasis for effective management must be at the national level.

Several initiatives can be pursued at a regional or sub-regional level. For example, sharing information and cooperation in scientific research are very important and are probably the easier to accomplish. However, other initiatives as a common fishery legislation and management system or a coordinated fishery surveillance and enforcement program could be more difficult to achieve.

Of significance here is the necessary action of Parties to CITES to implement the terms and conditions of the Convention with respect to imports of conch from third countries. It is also necessary the cooperation from non-parties to be cognizant and cooperate with the control systems of other countries. This is of particular interest to Jamaica as we are aware that in the past conch has been exported from Jamaica to non-parties of CITES within the region. However, more disturbing is the fact that up until very recently conch from Jamaica has entered member states that are Party to the Convention without the required CITES certification. Another serious concern to Jamaica is poaching by fishers from several countries within the Caribbean region. We have no reliable data to estimate the level of poaching, however, it is agreed that a significant portion of our conch and lobster resources are lost to poaching. Such loophole seriously undermines our efforts at proper management of our very valuable conch resources. Any regional initiative must give special attention to this problem.

BREVE ANALISIS SOBRE LA SITUACION DEL CARACOL ROSADO, *Strombus gigas* EN MEXICO

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INTRODUCCION

El caracol rosado o caracol reina (*Strombus gigas* L.) es uno de los recursos pesqueros de mayor valor económico en la región del Golfo y Mar Caribe mexicanos, siendo superado sólo por la langosta espinosa [*Panulirus argus* (Latreille)]. Su aprovechamiento comer-cial se remonta a la década de los cincuenta, desarrollándose particularmente en la Península de Yucatán, la cual está constituída por tres estados: Yucatán, Campeche y Quintana Roo. En la actualidad el recurso se considera sobre-explotado, desapareciendo prácticamente en los estados de Veracruz, Tabasco y Campeche.

ACTIVIDAD PESQUERA Y PRODUCCION

Durante los primeros años el acceso a la pesquería era libre. Esto llevó a que en 1975 se alcanzara una producción de 350 tm de pulpa de caracol, la más alta obtenida en la historia del país (Tabla 1). A finales de la década de los setenta las capturas se reducen significativamente, pasando de 122.6 tm en 1979 a 13.4 tm en 1980 (Tabla 1). Para 1981 y ante la drástica merma en la producción se consideró necesario iniciar un programa de regulación pesquera, autorizándose el ingreso a la pesquería exclusivamente a aquellos pescadores organizados en cooperativas. Sin embargo, para 1990 se hizo imperativo el que se cerraran importantes bancos de pesca, permitiéndose su captura únicamente en Banco Chinchorro, al sur del estado de Quintana Roo.

Hoy en día, Quintana Roo es prácticamente el único proveedor a nivel nacional. Por ejemplo, de las 350 tm extraídas en 1975, 315 fueron cosechadas en la zona de Banco Chinchorro. Allí las capturas se realizan a profundidades entre 3 y 4 metros, aunque se conoce que en el pasado las cosechas eran realizadas en aguas más someras. De Quintana Roo el recurso se comercializa hacia los sitios de interés turístico en las zonas de Cancún, Yucatán y Veracruz, donde su precio varia entre 35 y 40 pesos/kg (aproximadamente 5 dólares/kg.).

Después de las primeras medidas regulatorias implementadas en 1981 se logró una recuperación gradual de los desembarques alcanzando las 191 tm en 1986 (Tabla 1). Sin embargo, a partir de ese año se inicia un nuevo descenso, hasta que en 1991 sólo se reporta una producción de 27 tm (Tabla 1). Desde 1993 se autoriza únicamente a 3 cooperativas pesqueras a explotar el recurso en la zona de Banco Chinchorro. Estas cooperativas amparan a un total de 69 embarcaciones menores y 95 equipos de buceo, asignándoseles una cuota de

15 tm por cooperativa (2.5 tm/mes, durante 6 meses), restringiendo de esta manera el volumen anual a 45 tm (Tabla 1).

INVESTIGACION

A lo largo de los últimos años se han realizado estudios sobre la biología, cultivo y pesquería del caracol rosado con el objetivo de lograr un mejor aprovechamiento del recurso. Uno de los estudios (Desarrollo Científico y Tecnológico para el Cultivo de Caracol) fue desarrollado por el Centro de Investigaciones de Quintana Roo en una granja de cultivo ubicada en Chetumal. Los resultados no fueron tan esperanzadores, obteniéndose una tasa de crecimiento muy baja, posiblemente debido a que los organismos fueron sometidos a una alta manipulación (se medían y pesaban una vez al mes), lo cual generaba un alto nivel de tensión y el consiguiente desvío de energía destinada al crecimiento hacia otras actividades metabólicas. Por otra parte se encontró que la diferencia existente entre el tiempo en que el caracol rosado alcanza la talla mínima legal (20 cm de longitud entre el ápice de la espira y la terminación del canal sifonal) y la de madurez sexual, ocasiona que un 90% de la población sea explotada antes que alcance la primera maduración, con una clara repercusión sobre el recurso.

Otro de los estudios relevantes en la región estuvo orientado hacia el posible establecimiento de cuotas de captura para las cooperativas que operan en el centro y norte del Banco Chinchorro, específicamente en el Banco de Cozumel (centro) y en la plataforma oriental de Isla Mujeres, incluyendo el de Bajo Banderas (norte). El mismo fue desarrollado por el Centro Regional de Investigación Pesquera de Puerto Morelos, dependiente del Instituto Nacional de la Pesca, entre 1990 y 1995. El estudio abarcó 22 estaciones de muestreo, utilizando el método de conteo directo de individuos en un área determinada y extrapolando la información al área total de distribución de la población. Se estableció que el banco de pesca de Isla Mujeres abarca 25 km^2 y el Cozumel unos 290 km^2. La biomasa en Isla Mujeres fue estimada en 17 tm, aunque la técnica de muestreo utilizada tiende a sobrestimar los niveles de abundancia. Esto representa una disponibilidad de captura entre 5 y 8 tm, lo cual se traduce, en base al número de asociados en las cooperativas de la región, en cuotas de captura de 20 a 30 kg de pulpa de caracol/año/pescador, valores sumamente bajos. En Cozumel se estimó una biomasa de 1,100 tm (posiblemente también sobrestimada), con lo cual se podría dar apertura a una actividad pesquera controlada, con una producción máxima de 15 tm por temporada. Esta cifra debería ser revisada mediante monitoreos en los años subsiguientes.

REGULACIONES

La política del gobierno mexicano está orientada hacia el aprovechamiento de sus recursos, pero a su vez contempla el desarrollo de planes de protección para aquellas poblaciones cuyas existencias se vean amenazadas. Simultáneamente, las autoridades administrativas buscan poblaciones con mayor abundancia para que sean fuente de ingreso para quienes actualmente se dedican a este tipo de actividades recolectoras. En ningún

momento se abandona el criterio de preservarlas para que las futuras generaciones puedan seguir aprovechando las bondades que se derivan de estos recursos.

En el caso específico del caracol rosado, lo anterior se manifiesta con las siguientes medidas regulatorias:

1) Establecimiento de una veda indefinida en el estado de Yucatán (vigente desde el 26 de julio de 1988).

2) Restricciones al esfuerzo pesquero (establecidas en 1991).

3) Cierre por 3 años de las zonas de captura en Banco Chinchorro.

4) Definición de una temporada de captura en Quintana Roo del 1ro. de noviembre al 30 de abril y una de veda del 1ro. de mayo al 31 de octubre (establecida en 1994).

Así mismo, el aprovechamiento del caracol rosado se rige por lo señalado en la norma oficial mexicana para la captura en los estados de Campeche, Yucatán y Quintana Roo, expedida en abril de 1995, que contempla:

1) Determinación de una talla mínima de captura de 20 cm de longitud de concha.

2) Buceo autónomo o semi-autónomo como método de pesca autorizado.

3) Determinación de cuotas de captura en función de los resultados de las investigaciones científicas realizadas sobre el recurso.

4) Determinación de la cantidad de equipos autorizados para la extracción del recurso, en función de la asignación que estipule la Secretaría de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP) para cada concesionario.

5) Compromiso de los productores a presentar un reporte mensual sobre los resultados de sus operaciones, así como a participar en los programas de investigación que lleve a cabo la SEMARNAP en los términos que ésta defina.

El estado de Campeche no expide permisos para el aprovechamiento del caracol rosado y en Yucatán los estudios realizados indican que el recurso no se ha recuperado, por lo que se recomienda mantener la veda.

CONSIDERACIONES FINALES

De acuerdo a la filosofía vigente para la administración de los recursos pesqueros que enfatiza el aprovechamiento sustentable y la preservación de los mismos, es necesario evaluar la disponibilidad de caracol rosado a profundidades superiores a 10 metros. Igualmente, se deben tomar en cuenta los resultados de las diversas investigaciones científicas que recomiendan se establezcan los mecanismos que permitan al caracol rosado cumplir con su ciclo reproductivo.

A nivel regional, México recomienda el intercambio de la información científica entre los países, aprovechando experiencia de éstos y evitando repetir situaciones que no han rendido los resultados esperados. Sin embargo, la administración del recurso ha de considerarse un acto soberano de cada nación, conforme a las circunstancias económicas, técnicas, políticas y sociales imperantes.

Tabla 1. Desembarques del caracol rosado en la región de Banco Chinchorro, Mexico, entre 1972 y 1995.

Año	Captura (kg)
1972	66,479
1973	17,489
1974	138,048
1975	315,330
1976	252,405
1977	112,145
1978	31,580
1979	122,580
1980	13,402
1981	72,289
1982	65,118
1983	77,898
1984	99,000
1985	152,000
1986	191,000
1987	141,000
1988	128,000
1989	125,000
1990	51,000
1991	27,000
1992	30,000
1993	45,000
1994	45,000
1995	45,000

STATUS OF QUEEN CONCH, *Strombus gigas* IN MONTSERRAT

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INTRODUCTION

In the early 60s Montserrat lost one of the most productive queen conch breeding grounds it ever had due to the construction of a road on the south side of the Island. Conch was once harvested in very shallow waters less than 10 ft (3 m) from the shoreline. This area also served as a nursery ground. From the mid-60s onward, as the harvesting of conch gathered momentum, fish stocks began to show signs of decline.

In the early 80s a study of the queen conch (*Strombus gigas* L.) was done by Carl Berg. His findings showed that the stocks were threatened and needed special attention, with education to the public playing a major role. A booklet was developed for fishers. The booklet was so designed that if fishers were unable to read their children would be able to read to them.

FISHING ACTIVITIES

Nowadays, these stocks are heavily exploited by divers with the use of scuba equipment in depths beyond 120 ft (37 m). These fishers are usually supported by a boat and often a crew of 3 or 4. The queen conch can be found around the island. They are mostly harvested from the south to the north of the island on the leeward or Caribbean Sea side.

Harvesting of conch is done at specific times especially in days close to weekends. The harvesting of conch accounts for 1 to 3 mt per year with a market value of 3 dollars each. In some cases 2 or 3 are required to make 1 lb (454 g). Conch harvested without a lip is considered to be immature. The divers who harvest the conch are reporting that they are seeing less and less of the mature conch.

Some conch is imported from Nevis on a regular basis as our demand seems to exceed the supply. While we do not have the figures available, it does appear that the amount imported is significant.

CURRENT RESEARCH

Monitoring of landed conch is done at the mayor landing site (i.e., Plymouth). These are usually landed without the shell which in some cases is sold to tourists.

REGULATIONS

At present there is a Fisheries Act which was passed into law in 1982 but did not address the harvesting of conch. There is however a draft of the Organization of Eastern Caribbean States (OECS) Harmonized Fisheries Legislation which contains draft sections focusing on the conch.

With the assistance of the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP) a management plan for conch and other fish related species was drafted and is currently being reviewed. This management plan is being discussed with fishers at present in an effort to sensitize them of its contents and requirements. Elements of the management plan are:

1) Restricting the harvesting of conch with the use of scuba equipment.

2) Setting of minimum weight of animal in an effort to determine maturity.

3) Establishment of a closed season.

4) Restricting the number of persons allowed to harvest conch.

The management plan is being reviewed and is yet to be officially passed by the legislature and implemented.

FINAL CONSIDERATIONS

The future of the queen conch in and around Montserrat is unknown given the following:

1) The fact that the adult conch is going into deeper waters.

2) That scuba is being used to harvest them along with bags to load the animals on the bottom to be loaded in the boat.

3) High demand for conch locally.

4) The present volcanic activities have had a negative impact on the conch fishery.

5) Several sea grass beds are now covered with ash deposited into the sea.

6) Reefs dying because of ash clogging up the polyps.

7) Pyroclastic flows now making their way to the marine environment causing the sea to boil in some cases and building additional land space in the east of the island.

Given the present circumstances the only hope for the queen conch survival is for urgent action and hoping that the current volcanic activities will cease shortly. The proposed construction of a jetty in the north of the island which is located at the most sheltered beach on the island which is also a nursery ground for the queen conch. The need for sub-regional cooperation in managing the conch since that we are too close to Antigua, St. Kitts and Nevis.

LEGAL CONSIDERATIONS FOR FISHERY MANAGEMENT IN THE NETHERLANDS ANTILLES

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INTRODUCTION

The Netherlands Antilles consist of the islands of Saba, St. Eustatius, the south part of St. Martin, Curaçao, and Bonaire. Aruba is not part of The Netherlands Antilles since 1986. The Netherlands Antilles is an autonomous unit within the kingdom of The Netherlands. The Netherlands take care of defense and of foreign affairs, with all the other areas being regulated by The Netherlands Antilles. The most important conch resources in the Netherlands Antilles are found on Saba Bank, which is presently overfished.

LEGAL CONSIDERATIONS

When the constitution was drawn up in 1954, The Netherlands Antilles possessed a 3 nautical miles territorial sea and fisheries were strictly artisanal. The "Eilandenregeling Nederlandse Antillen" (ERNA; words in Dutch), which forms part of the constitution of The Netherlands Antilles, states that fisheries are the responsibility of the islands' governments. However, with the advent of the international law of the sea regime, which is clearly a central government matter, this original concept became outdated.

For years, there has been considerable legal confusion about the responsibility of the respective islands' government versus the central government and it was easy to challenge the regulations on constitutional grounds. In 1991, the islands agreed to give back part of their authority to the Central Government, and the Central Government Fisheries Law was enacted. However, you could still challenge the law on constitutional grounds, although this would be much less likely to succeed than before.

Now, all fishing from vessels heavier than 6 gross registered tonnage (GRT) or from which the deck is longer that 12 m (whichever comes first) fall under the central government law. The Judicial Department at the Department of General Affairs handles fisheries on the central government level. Within their respective 12 mile zones, the islands are free to apply their own fisheries regulations on vessels which are lighter than 6 GRT or smaller than 12 m. Part of the Saba Bank falls within the 12 mile zone of Saba and is regulated by the Saba Island Fisheries Ordinance. The other portion falls under the regime of the Central Government Fisheries Law.

REGULATIONS

The Central Government Fisheries Law stated (Official Bulletin 1991, No. 74) that it is forbidden to harvest queen conch, *Strombus gigas* L., which are less than 18 cm in length. If the meat has been removed from their shells, they must have a minimum weight of 225 g. St. Eustatius and St. Maarten have no local regulations. It is not the case of Curaçao, Bonaire, and Saba. Even more, Curaçao is the only island which has a fisheries section within its Department of Agriculture. For Curaçao, there is a proposal to ban all fishing of conch, lobster [*Panulirus argus* (Latreille)] and West Indian topshell (*Cittarium pica* L.) in the next 3 years. In Bonaire, conch are also protected with a minimum size of 10 cm.

EXPLOTACION DE LA CAMBOMBIA, *Strombus gigas* EN PANAMA

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INTRODUCCION

La cambombia (*Strombus gigas* L.) se localiza fundamentalmente en dos regiones de la costa Atlántica de la República de Panamá: en Bocas del Toro (en el limite con Costa Rica) y en el Archipiélago de San Blas. Ambas regiones son de difícil acceso. Al Archipiélago de San Blas se puede llegar solamente por avión, mientras que algunos sectores de Bocas del Toro tienen acceso por carretera, pero la mayoría de las comunicaciones se establecen por vía aérea. El poder adquisitivo de las personas que viven en estas áreas es muy bajo.

ACTIVIDAD PESQUERA

La cambombia se captura mediante el buceo a pulmón libre. Anteriormente, los pescadores la localizaban a 1.5 brazas (3.1 m) de profundidad. Hoy en día, estos deben descender a profundidades de hasta 10 brazas (20.5 m) y de acuerdo a sus observaciones, aún se puede encontrar a profundidades mayores. Sin embargo, el uso de equipo de buceo autónomo (tanques) está prohibido en Panamá.

Las mayores capturas se registran entre los meses de enero y mayo. Esto coincide con la época de sequía, que es cuando las aguas se encuentran más cristalinas (limpias). Las áreas de mayor abundancia en Bocas del Toro son la Isla del Escudo de Veraguas, Cayo de Agua, Bahía Azul y Punta Valiente. Una porción de las capturas en esta área se destina al consumo interno. Sin embargo, el poblador local no dispone del poder adquisitivo para comprar este producto, por lo que el mayor porcentaje del recurso se envía a la capital (vía aérea) para su posterior exportación. Las capturas del área de San Blas son enviadas, en su totalidad (no se exporta), para su consumo en la Ciudad de Panamá. Allí se comercializa en los restaurantes, hoteles o en el mercado público de mariscos. El pescador de Bocas del Toro orienta sus esfuerzos pesqueros, fundamentalmente hacia la langosta [*Panulirus argus* (Latreille)]. La pesca de la cambombia es realmente incidental. Se cree que en San Blas ocurre otro tanto, pero no hay certeza de ello.

Dados los problemas de acceso en estas regiones, no se dispone de una estadística confiable de los desembarques de la cambombia en Panamá, sin embargo la producción se podría estimar en unas 70,000 lb (31,780 kg) de carne anuales. También carecemos de información en cuanto a los volúmenes de exportación, ya que al ser un producto de bajo volumen, las cantidades exportadas se colocan en el rubro de "misceláneos" (productos varios). Sin embargo, en 1994 se hizo un esfuerzo por revisar los conocimientos de embarque

y se determinó que se habían exportado, aproximadamente, unas 90,000 lb (40,860 kg), pero esto incluía los Strombidos del área del Océano Pacífico (*Strombus galeatus* Swainson y *S. peruvianus* Swainson).

CONSIDERACIONES FINALES

De conversaciones recientes con empresarios de la industria, se desprende que el volumen de exportación ha descendido a unos 18,000 kg anuales. Esta disminución se relaciona con el establecimiento en el área de Bocas del Toro, del Parque Nacional Marino de Isla Bastimento, el cual funciona como una reserva marina en la que se prohibe la captura de cualquier especie.

ESTADO DE LA PESQUERIA DEL LAMBI, *Strombus gigas* EN REPUBLICA DOMINICANA

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INTRODUCCION

La República Dominicana cuenta con 1,575 km de costa, y unos 7,641 km^2 de plataforma insular, la cual es de poca anchura y se extiende hasta los 180 m de profundidad. Igualmente cuenta con los 3,740 km^2 del Banco de la Plata y los 778 km^2 del Banco de la Navidad. Comparte con su vecina, República de Haití, la isla de La Hispaniola. Su población está estimada en 7.5 millones de habitantes. La longitud del litoral dominicano es de 1,575 km de costa. En 1980, el proyecto de Estudio del Desarrollo Pesquero (PRODESPE-BID) establece un programa de muestreo en 8 zonas marino-costeras del país. De éstas, sólo cinco (Monte Cristi al noroeste, Samaná al nordeste, Saona y la Mona al este y Beata al suroeste) poseen una plataforma que alberga extensas praderas de hierbas marinas, bancos de coral pocos profundos y fondos areno-fangosos, ecosistemas que han sido el soporte de las poblaciones del lambí, *Strombus gigas* L., desde tiempos inmemoriales.

Por tradición, el lambí ha formado parte de la dieta de los habitantes ribereños de la Hispaniola, pero en los últimos tiempos, con el crecimiento de la población y el aumento del turismo, se ha incrementado la demanda por productos de origen marino, en especial del lambí. Esto trajo como consecuencia un incremento en su precio, lo cual provocó que los pescadores artesanales costeros orientasen sus esfuerzos de pesca hacia este recurso, lo que le ha llevado a niveles críticos de explotación. En República Dominicana, el lambí, junto a la langosta [*Panulirus argus* (Latreille)] constituyen los dos objetivos pesqueros que mayor presión reciben.

ACTIVIDAD PESQUERA

Hasta principios de la década del 70, la actividad de extracción del lambí en la República Dominicana se efectuaba mediante el buceo a pulmón libre y en aguas someras de hasta 15 pies (4.6 m) de profundidad. En esta época, se hizo popular el uso de equipo autónomo (tanques) en actividades recreativas/deportivas y los pescadores artesanales vieron la posibilidad de adoptar dicha técnica como método de pesca. Sin embargo, su elevado

costo limitó su utilización. Como alternativa, se comenzó a utilizar el compresor de aire (ensamblado localmente) y se convirtió en el equipo de primer orden para la pesca submarina hasta más de 100 pies (30 m) de profundidad.

En 1992, el Departamento de Recursos Pesqueros y la Agencia de Cooperación Internacional del Japón (JICA), llevaron a cabo una encuesta a nivel nacional y encontraron que en el país existen unos 10,415 pescadores, de los cuales un 20% se dedica a la pesca submarina, de los cuales, la mitad lo hace a pulmón. De acuerdo a estadísticas del Departamento de Recursos Pesqueros de la Secretaría de Estado de Agricultura, el nivel de producción ha ido disminuyendo, registrándose para 1984 un volumen de 640,033 kg, mientras que para 1991 fue de 223,562 kg. Lo mismo ocurre con las exportaciones. El Centro de Promoción de las Exportaciones ha notado un descenso en las mismas, pasando de 480,025 kg, en 1984 a 167,672 kg, en 1991. Los destinos principales de exportación son el mercado europeo y el de los Estados Unidos.

INVESTIGACION

La pesca del lambí ha ocasionado un importante impacto en sus poblaciones, llegando al extremo de que en menos de 22 años la mayoría fueron diezmadas. Sin embargo, de acuerdo a los resultados del Proyecto de la Pesca Artesanal de la Región Sur (PROPESCAR-SUR) y al informe de la Oficina de las Naciones Unidas para el Medio Ambiente (UNEP) (OCA/CAR WG.19/inf. 13), aún se conservan poblaciones importantes en la zona de Isla Beata, posiblemente por estar ésta en una zona protegida por la figura de Parque Nacional (Jaragua).

REGULACIONES

En la República Dominicana, la Ley de Pesca vigente (de 1962) no contempla regulación alguna para el lambí, por lo que las estrategias para su manejo se apoyan en Decretos Presidenciales. En este sentido, el Decreto No. 320 (octubre 1986) establece que el Departamento de Recursos Pesqueros es la autoridad encargada de otorgar permisos para la captura, confinamiento y comercialización de todas las especies de peces e invertebrados acuáticos, sea vivos o muertos, o con fines ornamentales o industriales.

Un poco más específico, el Decreto No. 312 (octubre 1986) prohibe la captura, posesión, procesamiento y comercialización de individuos de la especie *Strombus gigas* con tallas menores a los 25 cm de longitud de concha. Sin embargo, este decreto no considera otro tipo de regulaciones o la protección del recurso durante la época de desove.

CONSIDERACIONES FINALES

En la actualidad, el Congreso de la República Dominicana, con la asesoría de la Oficina de las Naciones Unidas para la Agricultura y la Alimentación (FAO), se encuentra trabajando para actualizar la Ley de Pesca y establecer una normativa que fomente la recuperación de las poblaciones que aún existen en las costas y bancos pesqueros y que permita el uso sustentable del recurso. Por otra parte, la República Dominicana apoya la

Convención sobre el Comercio Internacional de Especies Amenazadas de Flora y Fauna Silvestre (CITES), la cual incluye al lambí en su Apéndice II.

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN ST. LUCIA

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INTRODUCTION

St. Lucia has a simple but effective means of harvesting the queen conch (*Strombus gigas* L.), supplying a relatively low-keyed market. The popularity of conch as a delicacy increased dramatically within the past 15 years with the creation of a Friday-night street party and food fair in the northern town of Gros Islet (Nichols and Jennings-Clark 1994).

FISHING ACTIVITIES

Harvesting is carried out by 20 to 30 divers operating from a total of 10 boats, ranging between 20 to 30 ft (6.1 to 9.1 m) in length, using outboard engines. These fishers originate from the villages of Monchy, Gros Islet, and Maricule, and operate out of three landing sites in the north of the island. They use scuba tanks and dive to between 80 and 100 ft (24 and 30 m) to get the conch.

Stocks in the northern and southern areas of the island are targeted with landings of 300 to 500 conch per trip. Small-scale conch fishing also takes place from the southwest coastal villages, but this is done by free diving and is generally for home consumption. Conch is sold for US$ 3.00 to 4.00/lb (US$ 6.60 to 8.80/kg). The bulk of it is sold to the St. Lucia Fish Marketing Corporation, but a portion is also sold, directly by fishers, to local consumers. In 1995, the Fish Marketing Corporation purchased close to 30,000 lb (13,600 kg) of conch (in average, 2 conch weigh 454 g).

Total exports were close to 17,000 lb (7,718 kg) in 1995. Total conch landed that year was estimated in 50,000 lb (22,700 kg). However, this number could be doubled considering that the illegal trade still continues. Martinique is about an hour away. A boat with a 110 hp outboard engine cruises easily to Martinique. A study in 1980, found that over 15,000 lb (6,810 kg) of conch were illegally imported to Martinique from St. Lucia.

REGULATIONS

As part of the Fisheries (Turtle, Lobster, and Fish Protection) Regulations, the Department of Fisheries established in 1987 legislation designed to prevent over-exploitation of local conch stocks. Regulations include:

1) A minimum shell length of 18 cm and a minimum total weight 280 g (without digestive glands).

2) There is a provision for a closed season, but we have not instituted it yet.

3) No conch can be taken unless it possesses a flared lip (indicator of sexual maturity).

The Department of Fisheries has used education much more than enforcement of the law to get across to fishers the reason for the management measures. There is a small booklet for fishers which explains the reason for the size limit. It was written in simple enough English that, if the fisher is unable to read, a school child could read it to him (her).

FINAL CONSIDERATIONS

Stocks are thought to be sustaining the current level of fishing, although the shallow water stocks have been heavily exploited. Since 1993, the Department of Fisheries controls what is exported legally to the neighboring island of Martinique through the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). However, it is difficult to determine what the annual landings are because conch are held until sold to the local consumer, to our Fish Marketing Corporation or for export.

There are about 23 individuals involved in the export trade and the requirement for the forms is in place. The conch is exported in the shell and it must be examined previous to the trade. This is to ensure that the conchs are large and have a flared lip (mature).

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STATUS OF THE QUEEN CONCH, *Strombus gigas* IN ST. VINCENT AND THE GRENADINES

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INTRODUCTION

The people of St. Vincent and the Grenadines, the fishers, the government and everyone who either consumes fish or is involved in some aspect of the fishery, are very cognizant of the fact that the queen conch is a very important resource and it should be protected at all cost.

PRODUCTION

One of the best years in landings and export of conch was 1994. A total of 75,000 lb (34,050 kg) were recorded, of which 16 mt were exported. However, the Ministry of Agriculture and Labour have observed significant reduction in catches over the years. It is considered to be due to over-fishing, specially nearshore.

REGULATIONS

The government of St. Vincent and the Grenadines, through the Fisheries Act No. 8 of 1986, and in the exercise of the powers of that same act, conferred by section 45, considered the following regulations for the management of this vital marine resource:

1) No person shall take, sale or purchase or have in his possession any immature conch. Immature conch means a conch smaller than 7 in (18 cm), a conch which does not have a flared lip, or a conch with a total meat weight of less than 8 oz (225 g), after removal of the digestive gland;

2) The minister may, by published notice, declare any period as a closed season for conch; and

3) No person shall fish for conch during the period of a closed season for conch.

FINAL CONSIDERATIONS

In spite of the presence of this legislation on the statutes book, it is very difficult to monitor and enforce it. This is due to the fact that the fisheries sector of the government has very limited resources and can not monitor and patrol the extended territorial waters. Also, for every system that is introduced, people find ways and means of beating it.

It is absolutely necessary to identify no-take areas and spawning seasons. It is also necessary to determine the state of the stock, the maximum sustainable yield (MSY), and to establish closed seasons for an effective management plan.

STATUS OF THE QUEEN CONCH, *Strombus gigas* IN THE TURKS AND CAICOS ISLANDS

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INTRODUCTION

The Turks and Caicos islands are located in the Atlantic Ocean, at the south-eastern end of The Bahamas Islands chain and some 90 nm (116 km) to the north of Hispaniola. The fisheries is largely based on three distinct banks separated by deep water (1,500-2000 m). Tourism and fisheries resources are important to the Turks and Caicos Islands' economy. The catch is dominated by lobster [*Panulirus argus* (Latreille)] and conch (*Strombus gigas* L.), which are exported to the United States and Europe.

FISHING ACTIVITIES

Fishers generally leave between 7:00 and 8:00 am, and return to land by 4:00 pm. The length of a fishing day is variable and will depend, among other things, on weather. Each boat carries a boat driver and one to two divers. The boat driver is the key person. Most boats are made of fiberglass and have 55 to 70 hp outboard engines. Conchs are collected by free diving.

Catches for both lobster and conch are recorded as landed, at the end of each fishing day, at each of the 5 processing plants, where the meat is processed and frozen for export. Conchs are removed from their shells at sea, but lobsters are landed whole.

THE MARKET

Lobster is exported mainly as frozen tails and conch as frozen 100% clean meat. Conch fishing for export has been taking place for much of the century, and catch data for the conch date back to 1904 (Ninnes 1994). Until 1973, the fishing industry produced dried conch for export to nearby Caribbean islands (e.g., Haiti). The conch fisheries have expanded, with some fluctuations. By 1989, the fishers were in the worst state they had ever been. However, there has been a dramatic recovery between 1990 and 1994, with a dramatic increase in conch stock, and current catch rates are very high.

CURRENT AND FUTURE RESEARCH

Accurate daily conch catch and effort data, for individual vessels, have been analyzed for the period of 1977 to 1993 (although 84-85 data are missing). The data were used to carry out a stock assessment and provide models of stock population dynamics. The annual national conch quota is set using surplus production models (Schaefer 1954, 1957). The results suggest the maximum sustainable yield to be 681,000 kg (1.5 million pounds). The national quota for 1996-97 was set under this limit to allow for uncertainty in the calculation.

REGULATIONS

The Department of Environment and Coastal Resources (DECR) is the management authority for all Turks and Caicos Islands living resources (such as conch and lobster), as well as national parks. The DECR incorporates the fisheries and the national parks, recognizing the need for comprehensive management of living resources

The fisheries at the Turks and Caicos Islands appeared to be very healthy, in terms of consistently high landings, but the fishers are now forced to harvest at the outer limits of the bank, far from port. To ensure current high catch rates are maintained, controls have been implemented to prevent the stocks from being depleted. Major controls are currently being implemented:

1) Scuba is prohibited under the Fisheries Protection Regulation of 1989.

2) There is a national quota for total allowable catch. It is distributed among the processing plants. The quota is based on the conch catch per unit of effort data collected at the point of landing (processing plants).

3) A closed season is being proposed between August 1 to November 1 of each year. During this period, it will be illegal to land conch.

FINAL CONSIDERATIONS

The national quota will help achieve the conservation objectives of the fisheries. The closed season for conch is proposed to avoid reaching the quota limit; unemployed fishers fill the quota early during the closed season for lobster (March 31 to August 1). The region needs some standardize baseline studies for future comparisons in looking at the relative health of our local conch stocks.

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STATUS OF THE FISHERIES AND REGULATIONS REGARDING QUEEN CONCH, *Strombus gigas*, IN THE UNITED STATES, INCLUDING FLORIDA, THE COMMONWEALTH OF PUERTO RICO AND THE TERRITORY OF THE VIRGIN ISLANDS

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GENERAL INTRODUCTION

The information on the status of the queen conch fishery in the United States will be restricted to the data available from the state of Florida, the state and federal waters of the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands. The total shelf area (less than 200 m) of U.S. waters in the Caribbean is 2,115 square nautical miles, including Puerto Rico and the U.S.V.I. and excluding the area of the platform shared with the British Virgin Island (Figure 1).

FLORIDA

Introduction.- This summary is based on the work of Glazer and Berg (1994), Berg and Glazer (1995) and Stoner et al. (1996). Historically, Florida has never had a large queen conch fishery; however, a moderate commercial fishery existed through the mid-1900s to supply shells to the curio market.

Fishing activities.- Throughout the 1960s and into the 1970s, Florida's conch resources declined substantially and, in 1965, the state enacted legislation that prohibited the harvest of queen conch unless the meat was used. Ironically, the following year harvest reached record proportions with 25,563 kg taken from Florida waters. Conch harvest then declined dramatically until 1975, when the state limited harvest to 10 conchs/person/day.

Research.- The range of queen conch densities in Florida was reported by Glazer and Berg (1994) for 1987 to 1990 to be between 0.10 and 6.73 (mostly juveniles in the highest range) for an average of 2.4 conch/ha. This is probably the largest area covered (1423 ha) by a study of this kind but it is only 0.6% of the total area considered.

Regulations.- In 1985, legislation was enacted to prohibit all harvest of queen conch in state waters. In 1986, the ban was extended to include adjoining federal waters. Since that time (roughly two generations) there has been little change in abundance of the resource. In 1990, queen conch was designated a "protected species" in Florida waters to increase public awareness of the status of the species.

Final considerations.- There has been considerable speculation as to the lack of response by Florida's queen conch resource to rebound after such a long period of closure. Low numbers of adults and early stage larvae in Florida, and high concentrations of late-stage veligers associated with the Florida Current, suggest that conch populations in the Florida Keys depend upon larvae transported from the Caribbean Sea, possibly from Cuba, México, or Belize.

U.S.VIRGIN ISLANDS

Introduction.- The islands of St. Thomas and St. John share the same geological platform and the conch fishery will be considered together. St. Croix, which lies on a different platform will be examined separately.

Fishing activities.- U.S. Virgin Islands queen conch fishers made 1,537 queen conch trips during the 1991 (July) - 1994 (June) period. They also made 4,857 trips wherein no queen conch catch was reported, for a combined total of 6,394 trips. Total catch for these trips equaled 228,135 kg (502.5 thousand pounds). Queen conch contributed 14.1% of this total. For the U.S. Virgin Islands, total catch per queen conch trip averaged 36.4 kg (80.2 pounds). The associated value per trip averaged US$ 316, reflecting a price per kilogram of US$ 8.81 (per pound of US$ 4.00).

Almost 50% of the total number of queen conch trips in the U.S. Virgin Islands during 1991-94 yielded conch catches of less than 22.7 kg (50 pounds), but these trips represent approximately 25% of the total conch landed in the U.S. Virgin Islands. About 86% of the total number of trips in the U.S.V.I. yielded queen conch catches of less than 45.4 kg (100 pounds). Finally, only 1.5% of the total U.S.V.I. trips resulted in catches of 90.8 kg (200 pounds) or more, but the catch accounted for 6% of the total reported catches. There are no records of imports of frozen queen conch meat from the U.S. Virgin Islands.

Landings in St. Croix in 1991/92 were down more than 50 percent from 1981/82 (Table 1). The landings for 1993-1995 are still low as compared to 1981/1982. Reported queen conch trips in St. Croix averaged 109 per month during the 1991-1993 period. Trips during the July - September period were insignificant (less than two percent of the total), reflecting the closure of the fishery during these summer months. Although the number of trips taken by conch fishers during the months of the spawning closure is not significantly different from the trips taken the rest of the year, there are insignificant amounts of conch reported as landed. This means that fishers relocated their effort and targeted other species (e.g., spiny lobster). A survey of conch fishers (Rosario 1996) showed that of 46 conch fishers interviewed in the U.S. Virgin Islands, none target conch exclusive of any other reef resource; 96% target both conch and lobster. All conch commercially harvested in St. Croix is reported as harvested by SCUBA. However, Rosario (1996) reported that only 38% of the conch fishers use SCUBA gear exclusively, 29% harvest conch by skin diving, and 24% harvest conch by skin and SCUBA diving.

Research.- Surveys conducted in the U.S.V.I. in 1981, 1985 and 1990, showed a decline in conch densities from 37 to 11 conch/ha (Friedlander et al. 1994). The U.S.V.I. government

conducted a survey of the shell mounds around St. Croix in 1995 (T. Tobias, pers. comm.); regulations established in St. Croix in 1988, required that conch be landed in the shell. Of a total of 516 shells which were measured, 74% were sub-legal in shell size and 71% sub-legal in lip thickness. The majority of the shells measured (60%) were between 200 and 230 mm in shell length (Figure 2).

Regulations.- Overfishing in St. Thomas/St. John led to a 5-year closure of the conch fishery through December 1992. Unfortunately, when the fishery was reopened more restrictive measures were not implemented and the resource was depleted within a short period of time (Mr. Roy Adams, Commissioner, U.S.V.I. Department of Planning and Natural Resources, pers. comm.). The Island of St. Croix was not included in the moratorium on fishing for conch but had a set of regulations in place at the time. These regulations included a closed season (during the peak spawning months of July-September) and size limits for conch.

A review of available landings over the past decade indicates that overfishing is an apparent problem in the U.S. Virgin Islands and has led to the adoption of new conch regulations throughout the U.S. Virgin Islands (Title 12, Chapter 9A; July 12, 1994). Regulations governing the harvest of conch from waters under the jurisdiction of the Territory are:

1) An annual closed season from July 1 through September 30.
2) All conch landed must be alive and in the shell.
3) All conch harvested must be at least 23 cm (9 inches) in length or at least 9.5 mm (3/8-inch) in lip thickness in any location.
4) Conch harvested for personal use must not exceed 6 per day or 24 per boat, unless the person has a commercial fishing permit that entitles the fisher to a maximum of 150 conch per day.
5) Conch or conch shells that do not conform to the minimum size requirements may not be sold.

The information available from St. Croix suggests that although there is compliance with the regulation that requires that all conch must be landed in the shell, there is less compliance with the size limit.

PUERTO RICO

Introduction.- Trends in queen conch landings since the early 1980s generally indicate decreased abundance in Puerto Rico. Landings have declined from slightly over 181,600 kg (400,000 pounds) in 1983 to 45,400 kg (100,000 pounds) per year in 1992, a decrease of about 75% (Table 2). Average annual landings during the 11-year period of analysis equaled about 90,800 kg (200,000 pounds). An increase in conch landings has been reported since 1993 (Matos 1994, 1995), yet this increase in 1993 contributed only 7.6% to the total value of all fish and shellfish landings. Landings appear to be greater in May and August than in other months. Peak spawning activity has been reported from May to November with a peak in August which correlates with the highest water temperatures (Appeldoorn 1993).

Fishing activities.- Average total catch per trip associated with queen conch trips in Puerto Rico, during the 1988-93 period, equaled 38.2 kg (84.1 pounds) valued at US$ 160. Approximately 30% of the total number of queen conch trips reported in Puerto Rico during this same period, occurred during July 1 to September 30. Queen conch catch per trip in Puerto Rico during these three months averaged 29.9 kg (65.8 pounds), compared to the yearly catch per trip of 28.9 kg (63.7 pounds).

Commercial conch fishers were interviewed through the SEAMAP-Caribbean Program in Puerto Rico and the U.S. Virgin Islands in 1995 (46 in the Virgin Islands and 166 in Puerto Rico). In Puerto Rico, 11% of those interviewed fish exclusively for queen conch and 75% target spiny lobster (Rosario 1996). Eighty-five per cent (85%) of the divers employ multiple gear on a trip.

On average, 3-4 trips are made per week with 2 fishers/boat, and three tanks/trip/fisher on boats between 5.2 and 5.8 m (17 and 19 feet) in length. Of those interviewed, 66% harvest conch using SCUBA gear exclusively and 21% harvest conch by skin diving, while 11% harvest conch both by SCUBA and skin diving. Testimony at public hearings indicates that fishing is done at depths over 36.5 m (120 feet). On average, divers fish about 5 days per week, however, since multiple gear is used, all trips are not devoted to diving for conch. Decompression sickness (bends) is becoming increasingly more prevalent as divers are fishing deeper waters. González Román (1991) reported that ten (10) out of 37 diving accidents resulted in the commercial fisher being paralyzed.

Total annual conch trips in Puerto Rico during 1988-93 averaged 1,851 per year, of which about 93% were identified as having landed less than 68.1 kg (150 pounds) of conch meat. An average of 55% of the total number of queen conch trips in Puerto Rico during 1988-93 yielded catches of less than 22.7 kg (50 pounds). While less than 4% of the total number of queen conch trips in Puerto Rico during the 1988-93 period resulted in queen conch catches of 90.8 kg (200 pounds) or more, this small percentage of the trips yielded almost 21% of the total catch during the period.

The decrease in reported landings of conch has been attributed to population declines as a result of increase use of SCUBA, increase in market value, and a decrease in rate of catch reported by fishers. Eighty-nine per cent (89%) of the identified queen conch trips in Puerto Rico during 1988-93 used SCUBA, with the figure approaching 95% in 1993. Skin diving by comparison, represented only about 5% of the identified trips. When examined on a monthly basis over the 1988-93 period, SCUBA and similar gear represented more than 88% of the identified trips in all but two months. These months were July and August. Much of the cause for this is that the conch resource has been diminished to the extent that it is now principally harvested in deeper waters. This is in contrast to earlier years when free diving was the more popular mode of take.

There is no information available regarding the recreational catch of queen conch. A survey was recently begun in Puerto Rico to estimate the recreational catch, recreational effort and biological parameters of the individuals harvested. Socio-economic data is also being gathered from those interviewed. Preliminary results show that of 57 queen conch measured, 56 were juveniles (Ivan Mateo, pers. comm.).

The import market.- The shortage of local conch resources is substantiated by the record of imports of frozen meats since 1986 (Office of Statistics, Department of Agriculture, Puerto Rico; Mr. Roberto de Jesús, pers. comm.). Available statistics indicate a substantial increase in queen conch being imported into Puerto Rico in recent years. Total imports during 1985-87, equaled 31,326 kg (69,000 pounds), or less than 11,350 kg (25,000 pounds) per year. For the 18-month period ending in June of 1993, total imports exceeded 408,600 kg (900,000 pounds).

Research.- Rosario (1996) requested that fishers identify areas where juvenile and adult conch were found, as well as areas presently fished (conch strata), and no longer fished. Based on this information, a fishery-independent study conducted by Appeldoorn (1996) found average densities of 5.68 and 7.28 conch/ha in conch strata in the west and east coasts of Puerto Rico, respectively. The majority of individuals observed were juveniles. A study conducted off La Parguera, on the southwest coast, found 8.1 conch/ha (Torres Rosado 1987).

REGULATION IN FEDERAL WATERS

As mandated by the Magnuson Fishery Conservation and Management Act (Magnuson Act), the Caribbean Fishery Management Council (CFMC) is responsible for managing marine resources in federal waters surrounding Puerto Rico and the U. S. Virgin Islands. Federal waters are those extending beyond the 3 and 9 nautical miles territorial seas of the U.S.V.I. and Puerto Rico, respectively.

The CFMC has developed a Draft Fishery Management Plan (FMP) for the Queen Conch Resources of Puerto Rico and the United States Virgin Islands. The CFMC proposed in the FMP the following regulations, which are basically the same as in the U.S.V.I., for the federal waters in the U.S. Caribbean (Table 3):

1) Prohibit the possession of undersized queen conch defined as less than 23 cm (9 inches) total length (as measured from the tip of the spire to the distal end of the shell) or with less than a 9.5 mm (3/8-inch) lip thickness measured at the thickest point of the lip. Queen conch less than 23 cm (9 inches) total length will be considered illegal if it does not have at least one area of the shell lip measuring 9.5 mm (3/8-inch). All species in the fisheries management unit must be landed still attached to the shell.

2) Prohibit the sale of undersized queen conch and queen conch shells as defined.

3) Establish a bag limit for personal-use fishers of 3 queen conch per day, not to exceed 12 per boat; licensed commercial fishers may land 150 queen conch per day for the first year. The commercial fishers' quota will be lowered to 100 queen conch for the second year and to 75 the third year. The quota reduction is subject to review upon receipt of empirical information on which to base the decisions for new limits. All conch harvested under these provisions must conform to minimum size specifications and be landed still attached to the shell.

4) Establish an annual closed harvest season from July 1 through September 30 for queen conch.

5) Prohibit the harvest of queen conch in the exclusive economic zone (EEZ) using HOOKAH gear. Any person with queen conch and HOOKAH gear aboard a vessel in the EEZ will be presumed in violation of this prohibition.

FINAL CONSIDERATIONS

The FMP is currently under review. These regulations are being reviewed as we speak for final submission, and we hope approval by the U.S. Secretary of Commerce. These measures should resolve overfishing problems in the queen conch fishery and optimize production in the management area. However, if recruitment is dependent on nations in the eastern arc of the Caribbean Basin (which is highly likely) cooperative efforts by other communities will be required to effectively manage queen conch resources throughout their range.

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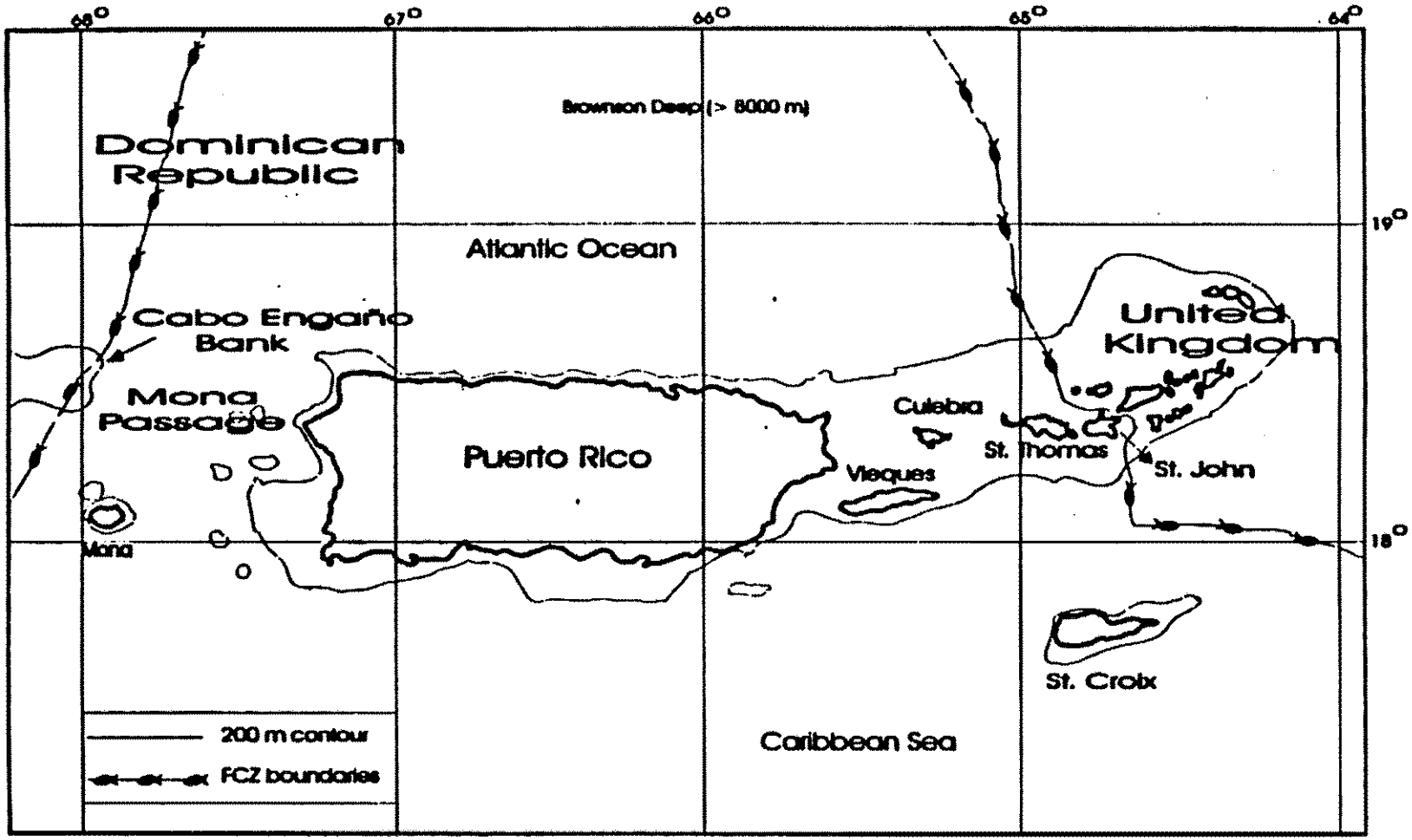

Figure 1. Puerto Rican and St. Croix shelves.

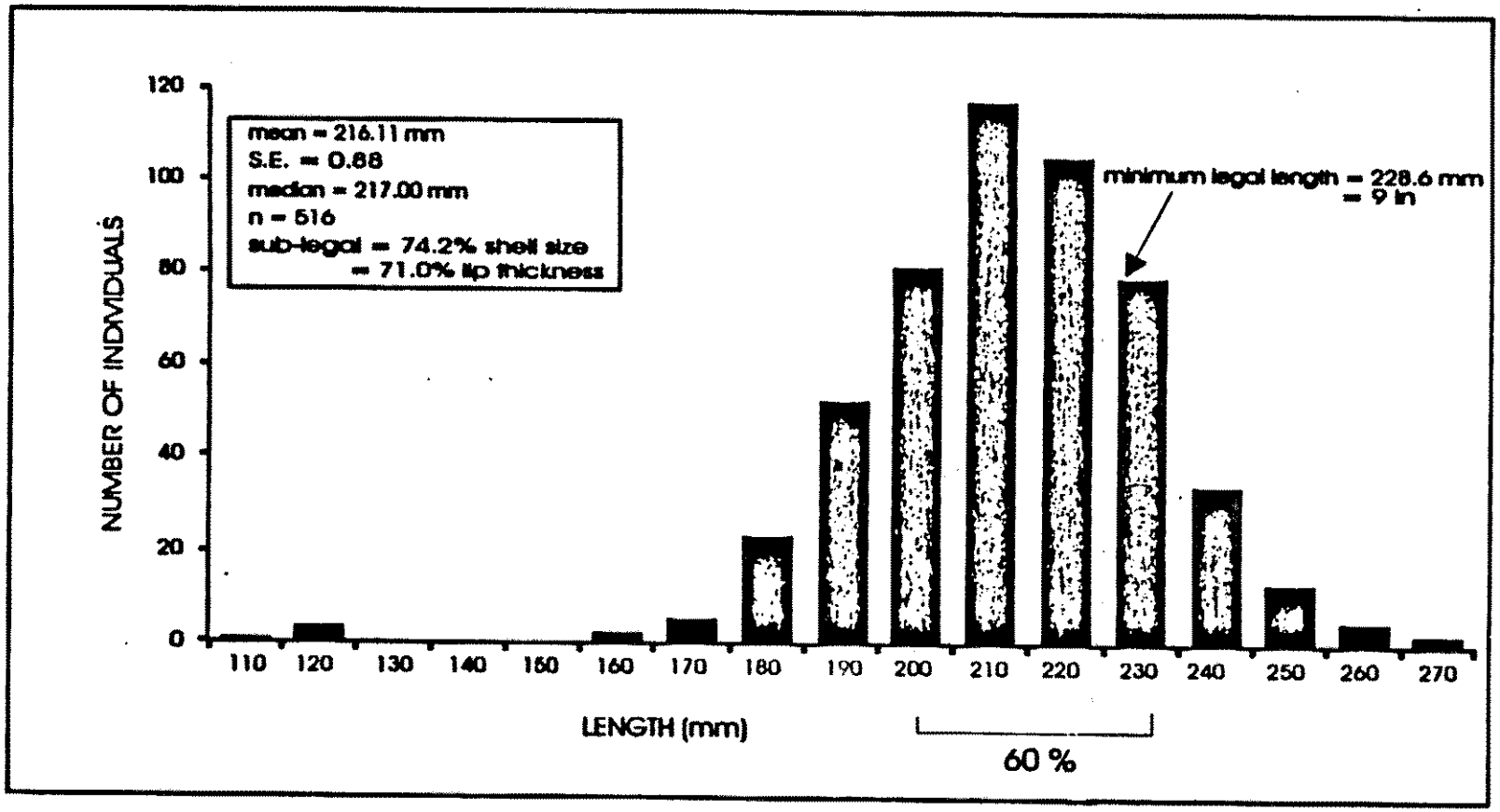

Figure 2. Length-frequency distribution of queen conch shells landed in St. Croix, USVI.

Table 1. Conch landings (in kilograms) for the U.S.V.I., 1981-1992 (from State/Federal report submitted to National Marine Fisheries Service).

	Year								
Area	81-82	82-83	83-84	84-85	89-90	90-91	91-92	93-94	94-95
STT/STJ	34.1	437.2	686.5	201.6	45.4*	0.0	0.0	0.0	0.0
STX	24,128.70	3,770.00	15,436.50	13,276.80	2,419.80	16,026.70	11,222.90	15,890.00	10,896.00
	Price per kilogram (US$, cleaned)								
STT/STJ	-	-	-	-	11.00	8.25	8.25	-	-
STX	-	-	5.50	5.50	7.70	8.80	8.80	-	-

STT = St. Thomas
STJ = St. John
STX = St. Croix

* illegal
- missing data/not available

Table 2. Conch landings (in kilograms) for Puerto Rico, 1983-1995.

Year	Landings (kg)	Price/kg
1983	182,739	3.00
1984	134,019	3.10
1985	118,542	3.40
1986	90,930	3.70
1987	70,512	4.10
1988	108,382	4.00
1989	72,907	4.50
1990	49,066	4.70
1991	49,103	4.80
1992	41,290	4.90
1993	74,972	5.10
1994	77,507	5.20
1995	97,832	5.10

Table 3. Summary of queen conch fishery regulations in U.S. waters

Area	Landings mt (year)	Density conch/ha	Regulations
Florida	Closed	1.5-2.4	Fishery closed in 1985 in both State and Federal waters. No significant change.
U.S.V.I	12.4 (1991-92) St. Croix	7.7-12.25	(a) an annual closed season from July 1 through September 30; (b) all conch landed must be alive and in the shell; (c) all conch harvested must be at least 23 cm (9 inches) in length or at least 9.5 mm (3/8-inch) in lip thickness in any location; (d) conch harvested for personal use must not exceed 6 per day or 24 per boat, unless the person has a commercial fishing permit that entitles the fisher to a maximum of 150 conch per day; and (e) conch or conch shells that do not conform to the minimum size requirements may not be sold.
Puerto Rico	108 (1995)	8.11 (5.68-7.28)	Regulations being considered.
U.S. Caribbean Federal waters	n/a	n/a	1) size limit 23 cm (9 inches) total length or with more than a 9.5 mm (3/8-inch) lip thickness measured at the thickest point of the lip. Must be landed still attached to the shell; 2) prohibit the sale of undersized queen conch and queen conch shells; 3) establish a bag limit for personal-use fishers of 3 queen conch per day, not to exceed 12 per boat; licensed commercial fishers may land 150 queen conch per day for the first year; 4) establish an annual closed harvest season from July 1 through September 30 for queen conch; and 5) prohibit the harvest of queen conch in the EEZ using HOOKAH gear.

SITUACION ACTUAL DE LA PESQUERIA DEL BOTUTO, *Strombus gigas* EN VENEZUELA

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INTRODUCCION

La pesca del botuto o guarura (*Strombus gigas* L.) en Venezuela data de muchos años. Sin embargo, su actividad se ha incrementado recientemente, dado el elevado valor comercial del recurso. Esto ha ocasionado un acelerado agotamiento del recurso en áreas tradicionales de captura.

Durante las tres últimas décadas, la pesquería del botuto se ha realizado casi exclusivamente en los archipiélagos de Los Roques (el cual es Parque Nacional) y Las Aves, La Orchila y Los Testigos. Estas son las únicas áreas donde aún se encuentran niveles poblaciones de relativa importancia, de hecho, el 90% de la producción nacional proviene de los mencionados archipiélagos (en ese orden de importancia). En el resto de las islas y en la región costera, los niveles poblacionales son muy bajos (Flores 1964, Laughlin et al. 1985).

ACTIVIDAD PESQUERA

Los pescadores capturan el molusco a través del buceo a pulmón libre. Son muy pocos los que utilizan buceo autónomo. Las embarcaciones están fabricadas en madera o fibra de vidrio y miden entre 3.7 y 11 metros de eslora. Generalmente están equipadas con motores que superan los 40 hp de potencia (Posada y Alvarez 1988). El número de pescadores varía entre 3 y 5, uno de los cuales es quien dirige la embarcación y es por lo general, el propietario de la misma.

La época y el esfuerzo de pesca han sufrido cambios notables en los últimos años. Laughlin et al. (1985), en un estudio que abarca desde 1980 a 1983, encontraron que el período de pesca duraba 6 meses (20 días al mes), lo cual se traducía en una captura promedio de 400 botutos/día/embarcación. Por su parte, Posada y Alvarez (1988), en un estudio entre 1984 y 1987, observaron que la actividad pesquera se realizaba durante 10 meses al año, con una captura promedio de 600 botutos/día/embarcación.

REGULACIONES

Laughlin et al. (1985) al demostrar el estado de sobre-explotación del recurso, proponen un plan de manejo basado en los siguientes puntos:

1) Una época de pesca de octubre a febrero, y una veda de marzo a septiembre (coincidente con la época de reproducción).

2) Cuotas máximas de pesca (30,000 botutos/temporada/-permiso).

3) Talla mínima de captura de 18 cm de longitud total de concha y prohibir la captura de ejemplares sin el labio de la concha totalmente desarrollado.

4) Creación de áreas de refugio donde se prohiba la pesca.

5) Legalizar, regular y controlar las exportaciones, así como mejorar el sistema de evaluación de las estadísticas pesqueras oficiales.

Sin embargo, en 1985 se decretó una medida de veda total para la pesca del botuto en el Parque Nacional Archipiélago de Los Roques. En 1989 se establece un período para la captura del botuto, siguiendo las recomendaciones de Laughlin et al. (1985) (Gaceta Oficial No. 34.325). En 1991, se decreta una veda general para todo el territorio nacional por un período de tres años (Gaceta Oficial No. 34777). Finalmente, en 1994, se prorroga la veda general nacional (Gaceta Oficial No. 35.533). A pesar de todo esto, el botuto se sigue capturando y exportando de manera ilegal.

CONSIDERACIONES FINALES

En el área del Archipiélago de Los Roques, Weil y Laughlin (1984) registran, entre 1981 y 1983, una densidad promedio de 0.11 ind/m^2. Esta cifra coincide con lo encontrado por Bastidas y Rada (en revisión). Esto pone de manifiesto que las medidas de veda total no han cumplido, a cabalidad, con su cometido (e.j., no han contribuído con un aumento en los niveles poblacionales). Sin embargo, el hecho de que la densidad promedio se haya mantenido estable durante los últimos 10 años, es un signo de que la actividad pesquera se ha mantenido controlada.

El hecho de que la pesca de botuto se realice de manera furtiva, aumenta el riesgo para el pescador y por lo tanto, el recurso adquiere más valor. Igualmente, debido a una tasa cambiaria que favorece al dólar, el mercado de exportación se ha hecho sumamente atractivo y hacia allí se dirige la producción nacional, específicamente hacia las islas de Curaçao, Bonaire y Martinica (Rodríguez y Posada 1994). Por otro lado, debido al carácter ilegal en las fases de extracción y comercialización, los niveles de producción no están siendo contabilizados dentro de las estadísticas pesqueras oficiales.

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OTHER COMMENTS

BARBADOS

Barbados does not have a major concern regarding the queen conch fishery given the nature of the island platform and that its fisheries are not centered on queen conch.

BERMUDA

Bermuda has a very strict set of regulations regarding their fisheries. The queen conch fishery has been closed since 1978 as a result of low conch population counts. Also, they have marine reserves for the protection of their resources and fisheries.

CUBA

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Se presenta a consideración un mecanismo que podría servir de base para la recuperación de las poblaciones del cobo (*Strombus gigas* L.):

Se recomienda establecer zonas protegidas para la reubicación y concentración de adultos del cobo. Estas zonas funcionarían como centros de emisión de larvas y constituirían una red regional que intentaría garantizar el reclutamiento de juveniles en el Atlántico tropical occidental.

Las conchas se colectarían, en grandes cantidades, de lugares naturales donde están expuestas a las pesquerías y a la extracción indiscriminada y se reubicarían en sitios protegidos, debidamente seleccionados. Esta reubicación se basaría en las características ecológicas y constituirían puntos estratégicos, desde el punto de vista regional, que se definirían según el patrón de las corrientes superficiales. Se debe realizar un exhaustivo análisis de la información existente sobre las corrientes, teniendo en cuenta la duración de la fase larval, lo cual permitiría establecer los puntos adecuados de la red.

Los sitios serían pastos marinos, someros, protegidos por vigilantes y guardacostas, o por guardaparques si es un área protegida. Estos sitios deben tener sedimentos blanquecinos, arenosos o areno-fangosos, con muy bajo contenido de materia orgánica.

ORGANISATION OF EASTERN CARIBBEAN STATES

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The Organisation of Eastern Caribbean States (OECS) is made up of 9 Member States: Anguilla, Antigua & Barbuda, the British Virgin Islands (BVI), Dominica, Grenada, Montserrat, St. Kitts/Nevis, St. Lucia, and St. Vincent & the Grenadines. Antigua & Barbuda, Montserrat, St. Lucia, St. Vincent & the Grenadines are represented here, and have made their presentations. I will briefly say something on behalf of the other Member States.

In 1991, landings in the other 5 states ranged between 5 mt for Dominica and 55.9 mt for the BVI. All the Members States, except for Anguilla and the BVI, have promulgated the OECS harmonized regulations:

1) immature conch are defined a having a meat weight less than 225 g, a shell length of less than 18 cm, and not having a flared lip;

2) there are some considerations to restrict the use of scuba and to established some sort of co-management arrangements; and;

3) reduction in nominal effort is being considered as an additional management option.

Of these 5 countries, 4 are in the process of developing management plans for the conch fishery. Anguilla, which is also the most recent member of the organization, is just starting to consider a management plan. The BVI already have a management plan for the fishery, but are in the process of reviewing it.

SECTION IV:

The Declaration of San Juan

INTERNATIONAL QUEEN CONCH CONFERENCE
SAN JUAN, PUERTO RICO
JULY 29-31, 1996

DECLARATION OF SAN JUAN

CONSIDERING

The importance of the conservation of queen conch (*Strombus gigas*) throughout the Wider Caribbean (see Appendix I of this Declaration);

The importance of the queen conch (*Strombus gigas*) fishery as a source of income and nutrition for the nations in the Caribbean Sea region;

The importance of conservation and sustainable use of the marine environment, including regionally-shared species such as *Strombus gigas*;

The serious problem of overfishing in many of the areas where *Strombus gigas* was once abundant, and the pressures on this important fishery resource from international trade;

The need to improve fishing practices and management of this fishery resource through national action and regional cooperation;

The listing of *Strombus gigas* in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and in Annex III of the Protocol Concerning Specially Protected Areas and Wildlife to the Cartagena Convention;

That the United Nations Convention on the Law of the Sea, done at Montego Bay, Jamaica, on 10 December 1982, provides the relevant legal principles for fishing in areas under national jurisdiction and on the high seas;

The relevance of the deliberations of this Conference to the goal of sustainable development as expressed at the United Nations Conference on Environment and Development, and the conservation of biological diversity as called for by the Convention on Biological Diversity;

The adoption, in August 1995, of the United Nations Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the adoption in November 1995, of the FAO Code of Conduct for Responsible Fisheries; and

efforts under the International Coral Reef Initiative, which includes promotion of sound management strategies for the sustainable yield of fisheries linked to coral reef ecosystems, such as the *Strombus gigas* fishery; and

The report of the November 1995 meeting of the Western Central Atlantic Fishery Commission of the Food and Agriculture Organization of the United Nations, which recognized that the status of *Strombus gigas* would be enhanced through the development of a common international management strategy for the *Strombus gigas* fishery.

DECLARES

1. Caribbean States continue to implement management practices, taking into account the FAO Code of Conduct for Responsible Fisheries, so as to effectively conserve and to produce sustainable *Strombus gigas* fisheries throughout the region;

2. Caribbean States continue to implement appropriate mechanisms to ensure the long-term conservation and sustainable use of *Strombus gigas* in waters under their national jurisdiction;

3. Caribbean States continue to take measures to protect critical habitats for *Strombus gigas*, including wetlands, seagrass beds, coral reefs, coastal areas and oceanic banks from degradation;

4. Caribbean States continue to promote and enhance the collection and exchange of *Strombus gigas* biological, socio-economic and other relevant data necessary to evaluate the conservation and utilization of the fishery resource;

5. Caribbean States continue to develop and establish mechanisms for international cooperation to prevent poaching and other illicit fishing of *Strombus gigas* without affecting the sovereignty of the State;

6. Caribbean States continue to effectively regulate international trade in *Strombus gigas* through strict adherence to existing conventions/agreements and through recognition of maritime jurisdictions; and

7. Caribbean States whenever possible and applicable continue to promote and strengthen mechanisms for regional and sub-regional cooperation that will enhance *Strombus gigas* fishery management.

AGREE

The participants (see Appendix I) at the International Queen Conch Conference Agreed:

I. To establish a working group, to be convened by the Caribbean Fishery Management Council, to develop a regional management strategy, in accordance with the best available scientific evidence, and subject to the national management strategies to be presented to all Caribbean States for their consideration and adoption;

II. To begin efforts to consider a consultative mechanism to promote the conservation and sustainable use of *Strombus gigas* and other marine living resources of the Caribbean Sea region;

III. To call upon all States of the Caribbean Sea region to cooperate in efforts to ensure the long-term sustainable use of *Strombus gigas*; and

IV. To meet as needed to discuss management of *Strombus gigas* and review progress toward sustainable use.

CONFERENCIA INTERNACIONAL SOBRE EL CARACOL REINA
(*Strombus gigas*)
SAN JUAN, PUERTO RICO
29 AL 31 DE JULIO DE 1996

DECLARACION DE SAN JUAN

CONSIDERANDO

La importancia de la conservación del caracol reina (*Strombus gigas*) a través de la Región Caribeña (ver el Apéndice I de esta Declaración);

La importancia de la pesca del caracol reina (*Strombus gigas*) como fuente de ingreso y nutrición para las naciones de la Región del Mar Caribe;

La importancia de conservar el medio ambiente marino, incluyendo las especies compartidas por la región, como lo es el *Strombus gigas*;

El serio problema de la sobrepesca en muchas de las áreas donde una vez abundaba el *Strombus gigas* y la presión que ejerce el comercio internacional sobre este importante recurso pesquero;

La necesidad de mejorar las prácticas de pesca y ordenamiento de este recurso pesquero por medio de la acción nacional y la cooperación regional;

La inclusión del *Strombus gigas* en el Apéndice II de la Convención sobre el Comercio Internacional de Especies de la Flora y la Fauna Silvestre en Peligro de Extinción, como también en el Anexo III del Protocolo Sobre las Areas y Vida Silvestre bajo Protección Especial, de la Convención de Cartagena;

Que la Convención de las Naciones Unidas sobre la Ley Sobre Derecho del Mar, aprobada en Montego Bay, Jamaica, el 10 de diciembre de 1982, provee los principios legales relevantes para la pesca en zonas bajo jurisdicción nacional, y en alta mar;

La relevancia de las deliberaciones de esta Conferencia para alcanzar el objetivo de un desarrollo sostenible, tal cual fuera expresado en la Conferencia de las Naciones Unidas sobre Ambiente y Desarrollo, y la conservación de la biodiversidad que reclama la Convención sobre Diversidad Biológica;

La adopción, en agosto de 1995, del Tratado de las Naciones Unidas para la Conservación y el Manejo de las Poblaciones de Especies Transzonales y Altamente Migratorias, y la adopción en noviembre de 1995 del Código de Conducta de la FAO para

la Pesca Responsable; y los esfuerzos bajo la Iniciativa Internacional para Arrecifes de Coral, que incluye la promoción de estrategias de manejo sólidas para el rendimiento sostenible de las zonas de pesca vinculadas a los ecosistemas de los arrecifes de coral, como lo son las zonas de pesca del *Strombus gigas*; y

El informe de noviembre de 1995 a raíz de la reunión de la Comisión de Pesca en el Atlántico Central Occidental para la Organización de Agricultura y Alimentos de las Naciones Unidas, la cual reconoce que la condición del *Strombus gigas* mejoraría al desarrollarse una estrategia común de ordenamiento internacional para la pesca del *Strombus gigas*.

DECLARA

1. Los Estados Caribeños continuarán implementando prácticas de manejo que tomen en cuenta el Código de Conducta de la FAO para la Pesca Responsable, de modo que se pueda conservar efectivamente al *Strombus gigas* y se pueda producir una pesca sostenible del *Strombus gigas* en toda la región;

2. Los Estados Caribeños continuarán implementando mecanismos apropiados para garantizar la conservación a largo plazo y el uso sostenible del *Strombus gigas* en aguas bajo jurisdicción internacional;

3. Los Estados Caribeños continuarán tomando medidas para proteger contra la degradación a los hábitats críticos del *Strombus gigas*, incluyendo humedales, praderas de yerbas marinas, arrecifes de coral, zonas costeras y bancos oceánicos;

4. Los Estados Caribeños continuarán promoviendo y mejorando la recolección e intercambio de datos biológicos y socio-económicos sobre la pesca del *Strombus gigas* necesarios para evaluar la conservación y el uso de los recursos pesqueros;

5. Los Estados Caribeños continuarán desarrollando y estableciendo los mecanismos para la cooperación internacional, de modo que se prevenga la pesca furtiva e ilegal del *Strombus gigas*, sin afectar la soberanía del estado;

6. Los Estados Caribeños continuarán regulando en forma efectiva el comercio internacional del *Strombus gigas* con estricto atenimiento a las convenciones y tratados existentes, reconociendo también las jurisdicciones marítimas; y

7. Los Estados Caribeños, siempre que sea posible y pertinente, continuarán promoviendo y fortaleciendo los mecanismos de cooperación sub-regional y regional para mejorar el ordenamiento de la pesca del *Strombus gigas*.

ACUERDA

Los participantes en la Conferencia Internacional sobre el caracol reina (*Strombus gigas*) acordaron:

I. Establecer un grupo de trabajo convocado por el Consejo de Administración Pesquera del Caribe para desarrollar una estrategia regional de ordenamiento, de acuerdo con la mejor evidencia científica disponible, sujeta a las estrategias nacionales de manejo, que se le presentará a todos los Estados Caribeños para consideración y adopción;

II. Iniciar esfuerzos para considerar un mecanismo de consulta con el objetivo de promover la conservación y el uso sostenible del *Strombus gigas* y otros ecursos vivos dentro de la Región del Caribe;

III. Hacer un llamado a todos los Estados de la Región del Mar Caribe para que cooperen con los esfuerzos para garantizar el uso sostenible a largo plazo del *Strombus gigas*; y

IV. Para reunirse según se necesite para discutir el manejo del *Strombus gigas* y revisar el progreso hacia el uso sostenible de este recurso.

CONFERENCE INTERNATIONALE SUR *Strombus gigas*
SAN JUAN, PORTO RICO
29-31 JUILLET 1996

DECLARATION DE SAN JUAN

CONSIDERANT

L'importance de la conservation de *Strombus gigas* dans les Caraïbes (voir Annexe I à la présente déclaration);

L'importance de la pêche à *Strombus gigas* en tant que source de revenus et produits alimentaires pour les nations de la région de la mer des Caraïbes;

L'importance de la conservation et de l'exploitation durable du milieu marin et de ses espèces partagées au niveau régional, telles que *Strombus gigas*;

Le problème grave que pose la surpêche dans de nombreuses régions où *Strombus gigas* était jadis abondante, et la pression qu'exerce le commerce international sur cette importante ressource;

La nécessité d'améliorer les pratiques de la pêche et la gestion de cette ressource par une action s'appuyant sur la coopération nationale et internationale;

L'inscription de *Strombus gigas* à l'Annexe II de la Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction, et à l'Annexe III du Protocole concernant les aires spécialement protégées et les espèces sauvages, de la Convention de Cartagena;

Que la Convention des Nations Unies sur le droit de la mer, adoptée à Montego Bay, Jamaïque, le 10 décembre 1982, fournit les principes juridiques applicables à la pêche dans les régions sous juridiction nationale et en haute mer;

La pertinence des délibérations de la présente Conférence quant à l'objectif de développement durable que s'est fixé la Conférence des Nations Unies sur l'environnement et le développement, et quant à la conservation de la diversité biologique demandée par la Convention sur la diversité biologique;

L'adoption, en août 1995, de l'Accord des Nations Unies pour la conservation et la gestion des stocks de poissons répartis de part et d'autre des frontières et des stocks de poissons hautement migrateurs, et l'adoption, en novembre 1995, du code de conduite de l'Organisation des Nations Unies pour l'agriculture et l'alimentation (FAO) pour une pêche

responsable, et les actions entreprises dans le cadre de l'Initiative internationale sur les récifs coralliens, notamment la promotion de stratégies de gestion rationnelles en vue d'un rendement durable des pêches liées aux écosystémes des récifs coralliens, telles que celle de *Strombus gigas*; et

Le rapport de la réunion de novembre 1995 de la Commission de la FAO sur les pêches de l'Atlantique central et occidental, qui reconnaît que l'élaboration d'une stratégie internationale commune de gestion de la pêche de *Strombus gigas* améliorerait l'état de cette espèce.

DECLARENT CE QUI SUIT

1. Les Etats des Caraïbes continuent d'appliquer des techniques de gestion tenant compte du code de conduite de la FAO pour une pêche responsable, afin de conserver effectivement *Strombus gigas* et de maintenir des pêches durables dans toute la région;

2. Les Etats des Caraïbes continuent d'appliquer les mécanismes appropriés pour garantir la conservation à long terme et l'exploitation durable de *Strombus gigas* dans leurs eaux territoriales;

3. Les Etats des Caraïbes continuent de prendre des mesures pour protéger de la dégradation les habitats critiques de *Strombus gigas*, notamment les zones humides, les herbiers marins, les récifs coralliens, les zones côtières et les bancs océaniques;

4. Les Etats des Caraïbes continuent de promouvoir et d'améliorer la collecte et l'échange des données biologiques, socio-économiques et autres sur *Strombus gigas*, nécessaires pour évaluer la conservation et l'explotation de cette ressource;

5. Les Etats des Caraïbes continuent d'élaborer et de mettre en place des mécanismes de coopération internationale pour empêcher le braconnage et autres formes de pêche illicites de *Strombus gigas* sans affecter la souveraineté des Etats;

6. Les Etats des Caraïbes continuent de réglementer effectivement le commerce international *Strombus gigas* en respectant strictement les conventions et accords actuels et en reconnaissant les juridictions maritimes; et

7. Les Etats des Caraïbes, lorsque c'est possible et pertinent, continuent de promouvoir et de renforcer des mécanismes de coopération régionale et locale qui amélioreront la gestion de la pêche de *Strombus gigas*.

CONVIENNENT

Les participants (voir Annexe I) à la Conférence internationale sur *Strombus gigas* conviennent:

I. D'établir un groupe de travail, qui sera convoqué par le Conseil de gestion de la pêche dans les Caraïbes, pour définir une stratégie de gestion régionale fondée sur les meilleures donnés scientifiques disponibles et tenant compte des stratégies nationales de gestion qui seront soumises â tous les Etats des Caraïbes pour examen et adoption;

II. De commencer â envisager un mécanisme consultatif destiné à promouvoir la conservation et l'explotation durable de *Strombus gigas* et des autres ressources biologiques marines de la région de la mer des Caraïbes;

III. D'en appeler à tous les Etats de la région de la mer des Caraïbes a fin qu'ils coopèrent pour garantir à long terme l'exploitation durable de *Strombus gigas*; et

IV. De se réunir lorsque c'est nécessaire afin de discuter de la gestion de *Strombus gigas* et d'examiner les progrès accomplis dans le sens de l'exploitation durable de cette espèce.

APPENDIX I

I Wider Caribbean States:

- Aruba
- Anguilla
- Antigua and Barbuda
- Bahamas
- Barbados
- Belize
- Bermuda
- Bonaire
- Brazil
- British Virgin Islands
- Cayman Islands
- Colombia
- Costa Rica
- Cuba
- Curaçao
- Dominica
- Dominican Republic
- El Salvador
- French Guiana
- Grenada
- Guadaloupe
- Guatemala
- Guyana
- Haiti
- Honduras
- Jamaica
- Martinique
- México
- Montserrat
- Nicaragua
- Panamá
- Saba
- St. Barthelemy
- St. Eustatius
- St. Kitts/Nevis
- St. Marteen
- St. Martin
- St. Vincent and the Grenadines
- St. Lucia
- Suriname
- Trinidad and Tobago
- Turks and Caicos
- U.S.A. (includes Puerto Rico, and the U.S. Virgin Islands)
- Venezuela

II Participant delegations to the International Queen Conch Conference, July 29-31, 1996, San Juan, Puerto Rico:

- Antigua and Barbuda
- Bahamas
- Belize
- Bonaire
- Colombia
- Curaçao
- Costa Rica
- Dominican Republic
- Haiti
- Honduras
- Jamaica
- México
- Montserrat
- Panamá
- Saba
- St. Eustatius
- St. Marteen
- St. Vincent and the Grenadines
- St. Lucia
- Turks and Caicos
- U.S.A. (includes Puerto Rico, and the U.S. Virgin Islands)
- Venezuela

<u>Other Participants</u>:

- CFRAMP
- CITES
- FAO
- OECS

INTERNATIONAL QUEEN CONCH CONFERENCE
SAN JUAN, PUERTO RICO

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Senior Fisheries Officer
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Mr. Osvaldo Pérez Molina
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COSTA RICA

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ST. VINCENT AND THE
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Minister Allan Cruickshank
Ministry of Agriculture & Labour

Mr. Kerwin Morris
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Mr. Joseph LaPlace
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Ms. Mildred Algarín
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